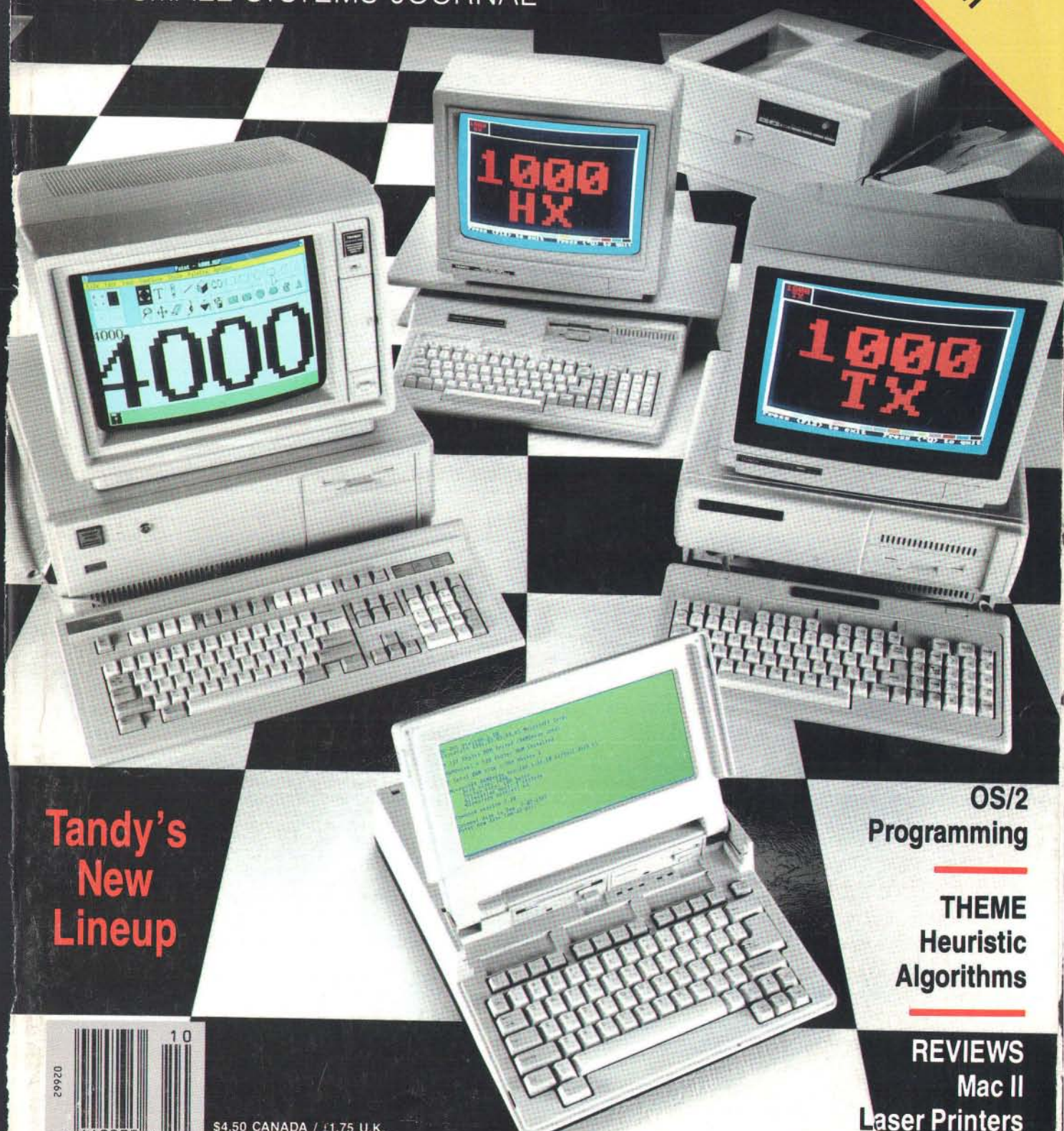
$3.50 U.S.A.

OCTOBER 1987

BYTE

THE SMALL SYSTEMS JOURNAL®

Includes BIX coverage of IBM and Macintosh



Tandy's New Lineup

OS/2 Programming

THEME Heuristic Algorithms

REVIEWS
Mac II
Laser Printers
Definicon DSI-780

10
0 440235 0
29920

$4.50 CANADA / £1.75 U.K.
A McGRAW-HILL PUBLICATION

bo C: NEW! erful optimizing ler ever

Sieve benchmark

	Turbo C	Microsoft® C
Compile time	*2.4*	13.51
Compile and link time	*4.1*	18.13
Execution time	*3.95*	5.93
Object code size	*239*	249
Execution size	*5748*	7136
Price	*$99.95*	$450.00

Benchmark run on an IBM PS/2 Model 60 using Turbo C version 1.0 and the Turbo Linker version 1.0; Microsoft C version 4.0 and the MS overlay linker version 3.51.

Technical Specifications

- ☑ Compiler: One-pass optimizing compiler generating linkable object modules. Included is Borland's high-performance Turbo Linker.™ The object module is compatible with the PC-DOS linker. Supports tiny, small, compact, medium, large, and huge memory model libraries. Can mix models with near and far pointers. Includes floating point emulator (utilizes 8087/80287 if installed).
- ☑ Interactive Editor: The system includes a powerful, interactive full-screen text editor. If the compiler detects an error, the editor automatically positions the cursor appropriately in the source code.
- ☑ Development Environment: A powerful "Make" is included so that managing Turbo C program development is highly efficient. Also includes pull-down menus and windows.
- ☑ Links with relocatable object modules created using Borland's Turbo Prolog into a single program.
- ☑ Inline assembly code.
- ☑ Loop optimizations.
- ☑ Register variables.
- ☑ ANSI C compatible.
- ☑ Start-up routine source code included.
- ☑ Both command line and integrated environment versions included.
- ☑ License to the source code for Run-time Library available.

Join more than 100,000 Turbo C enthusiasts. Get your copy of Turbo C today!

Minimum system requirements: All products run on IBM PC, XT, AT, PS/2, portable and true compatibles. PC-DOS (MS-DOS) 2.0 or later. 384K RAM minimum. Basic Telecom and Editor Toolboxes require 640K.

Borland International
4585 Scotts Valley Drive, Scotts Valley, CA 95066
Telephone: (408) 438-8400 Telex: 172373

Why more than 600,000 programmers worldwide are using Turbo Pascal today

The irresistible force behind Turbo Pascal's worldwide success is Borland's advanced technology. We created a compiler so fast, that Turbo Pascal® is now the worldwide standard. And there are more tools for Turbo Pascal than for any other development environment in the world.

You'll get everything you need from Turbo Pascal and its 5 Toolboxes

Turbo Pascal and Family are all you'll ever need to perfect programming in Pascal.

If you've never programmed in Pascal, you'll probably want to start with Turbo Pascal Tutor® 2.0, and as your expertise quickly grows, add Toolboxes like our

- Database Toolbox®
- Editor Toolbox®
- Graphix Toolbox®
- GameWorks®

and our newest,

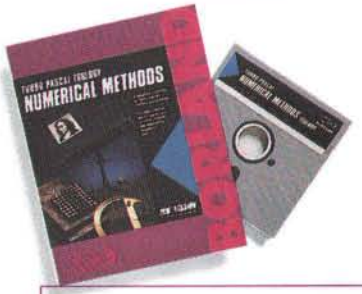
- Numerical Methods Toolbox™

And because Turbo Pascal is the established worldwide standard, 3rd party, independent non-Borland developers also offer an incredible array of programs for Turbo Pascal. ***Only $99.95!***

"Borland International's Turbo Pascal took the programming world by storm. A great compiler combined with a good editor at an astounding price, the package quickly came to be called, simply, Turbo—and has sold more than 500,000 copies.

Stephen Randy Davis, PC Magazine

Language deal of the century. *PC Magazine*"



For Scientists and Engineers: Turbo Pascal Numerical Methods Toolbox

The Numerical Methods Toolbox is a complete collection of Turbo Pascal routines and programs. Add it to your development system and you have the most comprehensive and powerful numerical analysis capabilities—at your fingertips!

The Numerical Methods Toolbox is a state-of-the-art mathematical toolbox with these ten powerful features:

- ☑ Zeros of a function
- ☑ Interpolation
- ☑ Differentiation
- ☑ Integration
- ☑ Matrix Inversion
- ☑ Matrix Eigenvalues
- ☑ Differential Equations
- ☑ Least Squares
- ☑ Fourier Transforms
- ☑ Graphics

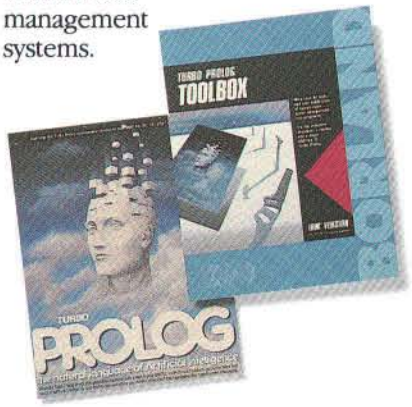
Each module comes with procedures that can be easily adapted to your own program. The Toolbox also comes complete with source code. So you have total control of your application.

Only $99.95!

B1-1131A

Turbo Prolog: The Natural Language of Artificial Intelligence

Whether you're a first-time programmer or an experienced one, Turbo Prolog's natural implementation of Artificial Intelligence soon shows you how to build expert systems, natural language interfaces, customized knowledge bases and smart information management systems.



Turbo Prolog and Turbo C work hand-in-hand

Turbo Prolog® interfaces perfectly with Turbo C® because they're both designed to work with each other.

The Turbo Prolog/Turbo C combination means that you can now build powerful commercial applications using two of the most powerful languages available.

Turbo Prolog's development system includes:

- ☑ A complete Prolog compiler that is a variation of the Clocksin and Mellish Edinburgh standard Prolog.
- ☑ A full-screen interactive editor.
- ☑ Support for both graphic and text windows.
- ☑ All the tools that let you build your own expert systems and **AI** applications with unprecedented ease.

Circle 32 on Reader Service Card
(Dealers: 33)

> "An affordable, fast, and easy-to-use language that will delight the newcomer . . . You experienced Prolog hackers will likewise be delighted, if not astonished, by the features and performance of the Turbo Prolog development environment.
>
> Turbo Prolog offers generally the fastest and most approachable implementation of that language."
>
> *Darryl Rubin, AI Expert*

How Turbo Prolog's new Toolbox adds 80 powerful tools and 8000 lines of source code

In keeping with Borland tradition, we've quickly added the new Turbo Prolog Toolbox™ to Turbo Prolog.

With 80 tools and 8000 lines of source code that can easily be incorporated into your own programs—and 40 sample programs that show you how to put these AI tools to work—the Turbo Prolog Toolbox is a highly intelligent, high-performance addition.
Only $99.95!

Turbo Prolog Toolbox features include:

- ☑ Business graphics generation: boxes, circles, ellipses, bar charts, pie charts, scaled graphics
- ☑ Complete communications package: supports XMODEM protocol
- ☑ File transfers from Reflex,* dBASE III,* 1-2-3,* Symphony*
- ☑ A unique parser generator: construct your own compiler or query language
- ☑ Sophisticated user-interface design tools
- ☑ Contains 40 example programs
- ☑ Easy-to-use screen editor: design your screen layout and I/O
- ☑ Calculated fields definition
- ☑ Over 8,000 lines of source code you can incorporate into your own programs

Tu
The most pov
comp

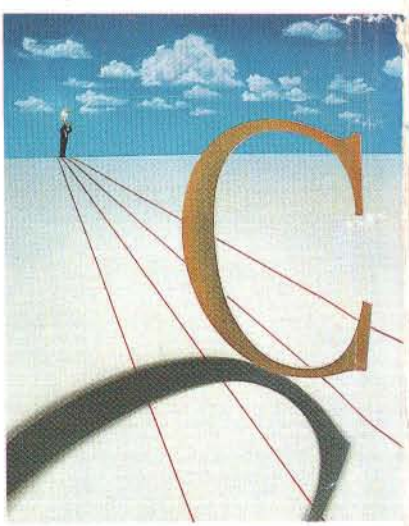
Our new Turbo C generates fast, tight, production-quality code at compilation speeds of more than 13,000 lines a minute!

It's the full-featured optimizing compiler everyone has been waiting for.

Switching to Turbo C, or starting with Turbo C, you win both ways

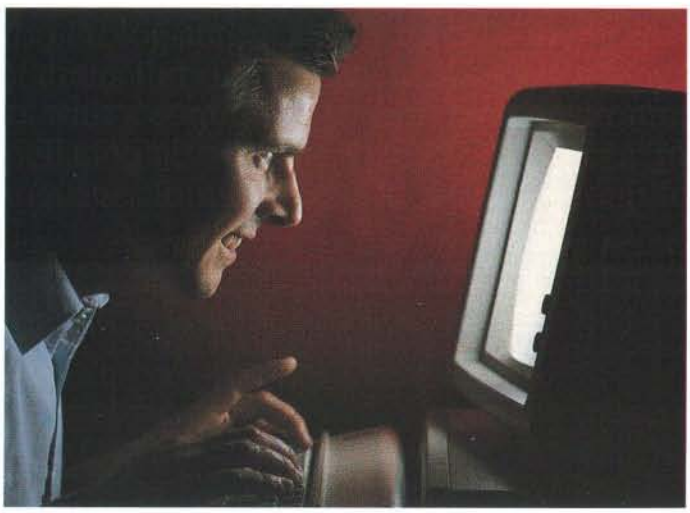
If you're already programming in C, switching to Turbo C will make you feel like you're riding a rocket instead of pedaling a bike.

If you're never programmed in C, starting with Turbo C gives you an instant edge. It's easy to learn, easy to use, and the most efficient C compiler at any price.
Only $99.95!



> "Turbo C does look like What We've All Been Waiting For: a full-featured compiler that produces excellent code in an unbelievable hurry . . . moves into a class all its own among full-featured C compilers . . . Turbo C is indeed for the serious developer . . . One heck of a buy—at any price."
>
> *Michael Abrash, Programmer's Journal*

Turbo C, Turbo Basic, Turbo Pascal and Turbo Prolog: technical excellence



"Borland International's Turbo Pascal, Turbo Basic and Turbo Prolog automatically identify themselves, by virtue of their 'Turbo' forenames, as superior language products with a common programming environment. The appellation also means to many PC users a 'must have' language. To us Turbo C looks like a coup for Borland."

Garry Ray, PC Week

B1-1131A

Turbo Basic introduces its powerful new Telecom, Editor and Database Toolboxes

NEW!

Turbo Basic® is the breakthrough you've been waiting for. The same power we brought to Pascal with Turbo Pascal has now been applied to BASIC with Turbo Basic.

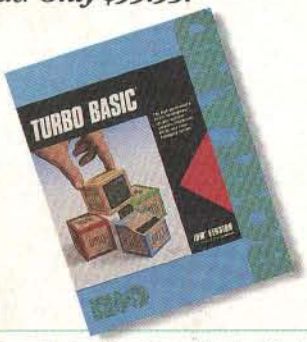
Compatible with BASICA, Turbo Basic is the high-performance, high-speed BASIC you'd expect from Borland.

> "Borland has created the most powerful version of BASIC ever."
> *Ethan Winer, PC Magazine*

Basically, Turbo Basic is all you need

It's a complete development environment which includes an incredibly fast compiler, an interactive editor and a trace debugging system. It outperforms all its rivals, and because it's compatible with BASICA, you probably already know how to use it.

Includes a free MicroCalc™ spreadsheet complete with source code. ***Only $99.95!***



A technical look at Turbo Basic

- ☑ Full recursion supported
- ☑ Standard IEEE floating-point format
- ☑ Floating-point support, with full 8087 (math co-processor) integration. Software emulation if no 8087 present
- ☑ Program size limited only by available memory (no 64K limitation)
- ☑ VGA, CGA, and EGA support
- ☑ Access to local, static, and global variables
- ☑ Full integration of the compiler, editor, and executable program, with separate windows for editing, messages, tracing, and execution
- ☑ Compile, run-time, and I/O errors place you in the source code where error occurred
- ☑ New long integer (32-bit) data type
- ☑ Full 80-bit precision
- ☑ Pull-down menus
- ☑ Full window management

NEW!

Telecom Toolbox is a complete communications package which takes advantage of the built-in communications capabilities of BASIC—use as is or modify.

- Pull-down menus and windows
- XMODEM support
- VT 100 terminal emulation
- Captures text to disk or printer
- PhoneBook file
- 300, 1200, 2400 baud support
- Supports script files
- Fast screen I/O
- Supports most of XTalk's command set
- Manual dial and redial options

Use Telecom Toolbox to embed communications capabilities into your own programs and/or build your own communications package. Source code included for all Toolbox code and sample programs. ***Only $99.95!***

For the dealer nearest you or to order by phone call

(800) 255-8008

in CA (800) 742-1133 in Canada (800) 237-1136

BORLAND INTERNATIONAL

SUMMER BREAK SPECIAL!
Buy Turbo Basic and Get a **FREE** Product
See your dealer for details!

NEW!

Database Toolbox means that you don't have to reinvent the wheel each time you write new Turbo Basic database programs.

- ☑ "Trainer" shows you how B+ trees work. (Simply key in sample records and you'll see your index being built.)
- ☑ Turbo Access instantly locates, inserts or deletes records in a database—using B+ trees.
- ☑ Turbo Sort sorts data on single items or on multiple keys and features virtual memory management for sorting large data files.

Source code included.
Only $99.95!

NEW!

Editor Toolbox is all you need to build your own text editor or word processor. Includes source code for two sample editors.

First Editor is a complete editor ready to include in your programs, complete with windows, block commands and memory-mapped screen routines.

MicroStar™ is a full-blown text editor with a complete pull-down menu user interface, and gives you

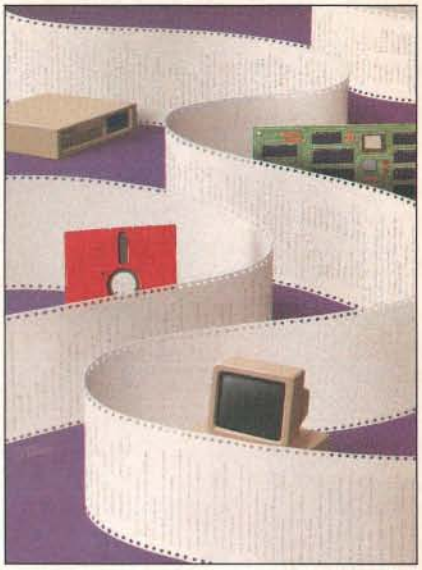
- Wordwrap
- Undo last change
- Auto-Indent
- Find and Find/Replace with options
- Set left/right margins
- Block mark, move and copy
- Tab, insert, overstrike modes, line center etc.

Includes source code.
Only $99.95!

B1-1131A

BYTE

OCTOBER 1987
VOLUME 12
NUMBER 11



Features/99

Contents

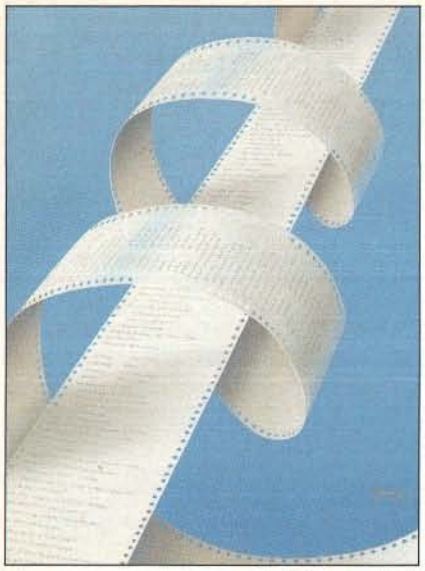
FEATURES 99

The four new Tandy computers and Tandy's (long-awaited) first laser printer.

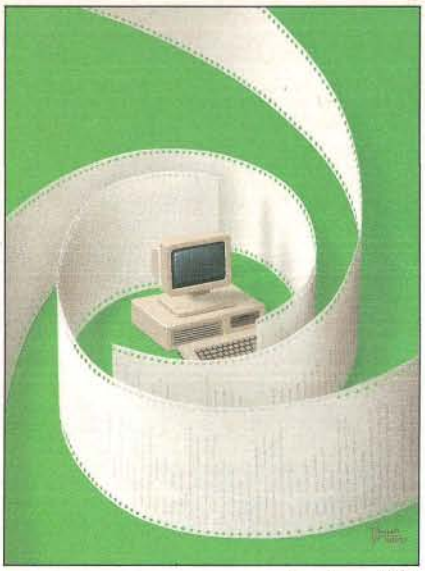
THEME: Heuristic Algorithms 147

REVIEWS 193

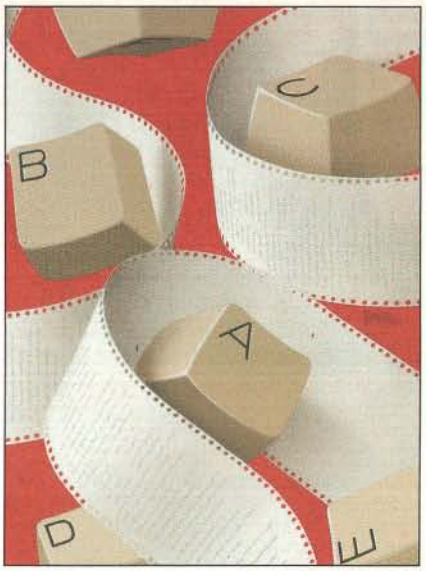
Cover photo by Paul Avis



Themes/147



Reviews/193



Kernel/249

KERNEL 249

LISTINGS

DEPARTMENTS

BEST OF BIX

BYTE (ISSN 0360-5280) is published monthly with additional issues in June and October by McGraw-Hill Inc. Founder: James H. McGraw (1860–1948). Executive, editorial, circulation, and advertising offices: One Phoenix Mill Lane, Peterborough, NH 03458, phone (603) 924-9281. Office hours: Monday through Thursday 8:30 AM–4:30 PM, Friday 8:30 AM–1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, P.O. Box 6821, Piscataway, NJ 08855. Postmaster: send address changes, USPS Form 3579, undeliverable copies, and fulfillment questions to BYTE Subscriptions, P.O. Box 6821, Piscataway, NJ 08855. Second-class postage paid at Peterborough, NH 03458 and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Subscriptions are $22 for one year, $40 for two years, and $58 for three years in the U.S. and its possessions. In Canada and Mexico, $25 for one year, $45 for two years, $65 for three years. $69 for one year air delivery to Europe. 31,000 yen for one year air delivery to Japan, 15,600 yen for one year surface delivery to Japan, $37 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $3.50 in the U.S. and its possessions, $4.25 in Canada and Mexico, $4.50 in Europe, and $5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Printed in the United States of America.

Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

Subscription questions or problems should be addressed to: BYTE Subscriber Service, P.O. Box 6821, Piscataway, NJ 08855.

Section art by Robert Tinney

BYTE

BIX

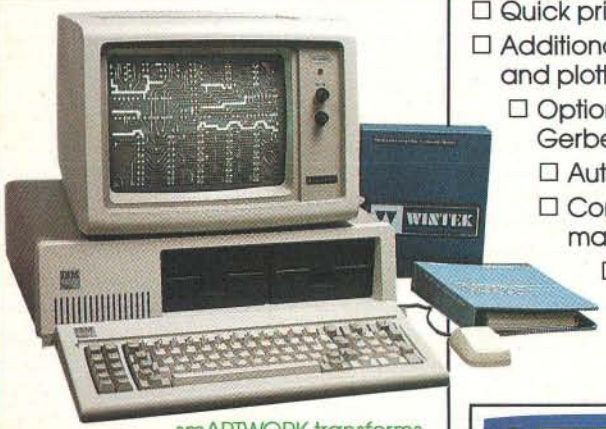
EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, New Hampshire 03458, (603) 924-9281.
West Coast Branch Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-6292.
New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
BYTEnet: (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud). **Fax:** (603) 924-7507. **Telex:** (603) 924-7861.
SUBSCRIPTION CUSTOMER SERVICE: Non-U.S. (201) 837-1315; inside U.S. (outside N.J.) 1-800-423-8272; (inside N.J.) 1-800-367-0218.

smARTWORK® Keeps Getting Smarter

NEW
Autorouter Included
Still $895

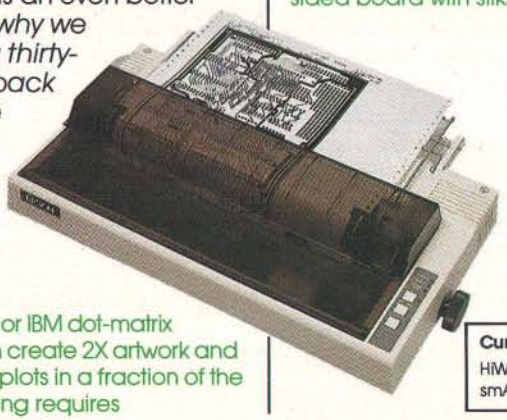
Smarter Artwork

Three years ago, Wintek engineers created smARTWORK to reduce the time and tedium of laying out their own printed-circuit boards. Thousands of engineers have since discovered the ease of use and sophistication that makes smARTWORK the most popular PCB CAD software available. And thanks to them, smARTWORK keeps getting better.



smARTWORK transforms your IBM PC into a PCB CAD system

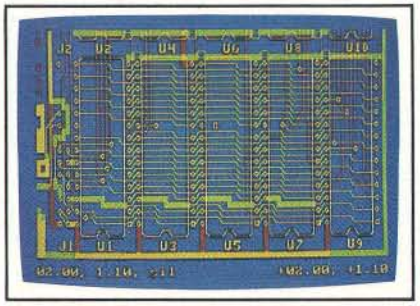
Interactive routing, continual design-rule checking, pad shaving, and production-quality 2X artwork have always been a part of smARTWORK. And now that many customer suggestions have become a part of the software, smARTWORK is an even better value. *That's why we offer it with a thirty-day money-back no-nonsense guarantee.*



Using an Epson or IBM dot-matrix printer, you can create 2X artwork and 1X or 2X checkplots in a fraction of the time hand-taping requires

New smARTWORK Features

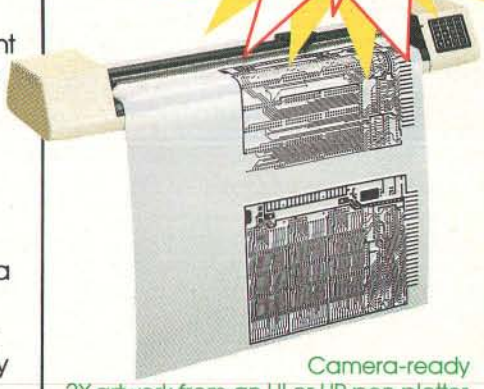
- ☐ Silkscreen layer for component placement and identification
- ☐ Text capabilities for all three layers
- ☐ Selectable trace widths and pad shapes and sizes
- ☐ User-definable library
- ☐ Ground planes created with a single command
- ☐ Solder-mask and padmaster plots generated automatically
- ☐ Quick printer 2X checkplots
- ☐ Additional drivers for printers and plotters
- ☐ Optional drill-tape and Gerber photoplotter utilities
- ☐ AutoCAD® .DXF file output
- ☐ Completely updated manual
- ☐ 800 number for free technical assistance



2" by 4" section of a 10" by 16" double-sided board with silkscreen layer

Current Versions

HiWIRE	V1.0r2
smARTWORK	V1.3r0



Camera-ready 2X artwork from an HI or HP pen plotter

The Smart Buy. Guaranteed.

Still priced at $895, smARTWORK is proven, convenient, and fast. Our money-back guarantee lets you try smARTWORK for 30 days at absolutely no risk. Call toll free (800) 742-6809 today and put smARTWORK to work for you tomorrow. That's smart work.

System Requirements

- ☐ IBM PC, PC XT, or PC AT with 384K RAM, and DOS V2.0 or later
- ☐ IBM Color/Graphics Adapter with RGB color or B&W monitor
- ☐ IBM Graphics Printer or Epson FX/MX/RX-series printer, and/or
- ☐ Houston Instrument DMP-40, 41, 42, 51, 52, or Hewlett-Packard 7470, 7475, 7550, 7580, 7585, 7586 pen plotter
- ☐ Optional Microsoft Mouse

Wintek Corporation
1801 South St.
Lafayette, IN 47904
Telephone: (800) 742-6809
In Indiana: (317) 742-8428
Telex: 70-9079 WINTEK CORP UD

WINTEK®

Europe: RIVA Terminals Ltd., England, Phone: 04862-71001, Telex: 859502 / Australia: Entertainment Audio Pty. Ltd., Phone: (08) 363-0454 or (008) 88 8414 / Brazil: Comicro Informatica E Tecnologia Ltda., Phone: (041) 224-5616

EDITORIAL

BIX's New Pyramid 9820

The BIX community, which numbers more than 17,000 users, can now get much bigger because a larger and faster computer is going on-line. Our Pyramid 9820, as delivered, will support 224 simultaneous BIX users and can expand to support at least 350 users. In our simulations, the Pyramid 9820 ran the BIX conferencing software with very fast response times—even under peak user loads.

We could also expand our system by adding more processors to support a much larger number of users. If we ever exceed the capacity of one Pyramid, further expansion is possible by networking multiple Pyramids with NFS, the network file system developed by Sun.

We considered several good contenders for the role of BIX host. The Pyramid 9820 won because it gives us, in addition to high performance and cost-effectiveness, the reassurance that comes with seeing every essential feature already working at the time of purchase.

System Specifics

Our new Pyramid 9820 computer has dual 32-bit processors based on a RISC (reduced instruction set computer) architecture and runs the OSx operating system; this is Pyramid's way of simultaneously supporting both Berkeley 4.2 BSD and System V versions of Unix. While the Pyramid 9820 can have as much as 128 megabytes of RAM, ours has "only" 32 megabytes. Each of the Pyramid CPUs has 528 registers.

The Pyramid 9820, which has a system computation of 13 million instructions per second, can be upgraded to a three-processor 9830 or a four-processor 9840. These upgrades would increase system computation to 19 and 25 MIPS, respectively, according to Pyramid.

The RISC CPUs execute most instructions in a single 100-nanosecond cycle. Each CPU has its own 16K-byte instruction cache and 64K-byte data cache in order to reduce memory-access time. Floating-point processors are included in each CPU.

Pyramid's multiprocessor architecture is symmetrical. That is to say, neither processor is master or slave—each can execute both system and user tasks, so that a new task goes to the next available processor. Both CPUs share a single copy of the Unix kernel. In our previous BIX system, performance was at times constrained because even though four 68020s were all functioning as CPUs, only one of them could run Unix kernel tasks.

Input/Output

I/O performance is critical in an application like BIX. The CPUs and terminal processors in the Pyramid 9820 communicate over a 40-megabyte-per-second 32-bit system bus called the XTEND bus. In addition to two terminal processors with asynchronous ports, our Pyramid 9820 has two synchronous X.25 processors, each of which can handle up to 56K bits per second. The intelligent I/O processor in the Pyramid 9820 uses an AMD 29116 processor and 14 parallel direct-memory-access channels, with a bandwidth of 5 megabytes per second per channel. Pyramid says the aggregate I/O throughput is 11 megabytes per second per I/O subsystem. We ordered the 9820 with two I/O subsystems installed.

Since conferences reside on disks, BIX performance depends on fast disk I/O. The Pyramid 9820 and its I/O subsystem use the ESMD disk interface to transfer data at up to 2½ megabytes per second, using overlapping seeks and rotational position sensing to increase the rate of transactions.

System Software

Pyramid's dual-port OSx operating system provides both major Unix standards concurrently: Berkeley 4.2 BSD and AT&T System V. We're running CoSy under System V. The most remarkable thing about Pyramid's implementation of Unix is that it enables the CPUs to operate symmetrically and to share the burden of the Unix kernel. The tasks handled by the kernel are, of course, vital to system performance, including handling of interrupts and of system calls.

By Pyramid's estimate, a master-slave dual processor is limited in performance to about 1.5 times the performance of a single-processor system. The symmetrical implementation of dual processors, according to Pyramid, boosts the performance of two processors to 1.85 times that of a single processor. Moreover, Pyramid 9000 family systems like the 9820 can be upgraded to as many as four CPUs, with all of them sharing system and user tasks.

Pyramid's version of Unix implements virtual memory with demand paging, to provide 4 gigabytes of directly addressable memory space for each Unix process. Pages are 2K bytes each. The file system has a 2K-byte physical-block size and an 8K-byte logical-block size. The Pyramid version of Unix supports all the features of the Berkeley 4.2 BSD Fast File System to provide faster storage and retrieval. Programs written for System V can take advantage of the Berkeley Fast File System.

Pyramid also has a virtual disk facility that is part of OSx. The virtual disk permits concatenation of multiple partitions into a single large file system. Disk partitions can be larger than the largest physical disk. In addition, the virtual disk facility permits "striping" of virtual disk files. A striped disk is made up of two or more pieces of one or more physical devices. The striped file uses an interleaving algorithm to translate block numbers of the logical disk into those of the physical disk. The result is that files can be striped across multiple disks to achieve greater system I/O throughput because I/O activity is distributed evenly across several drives or controllers.

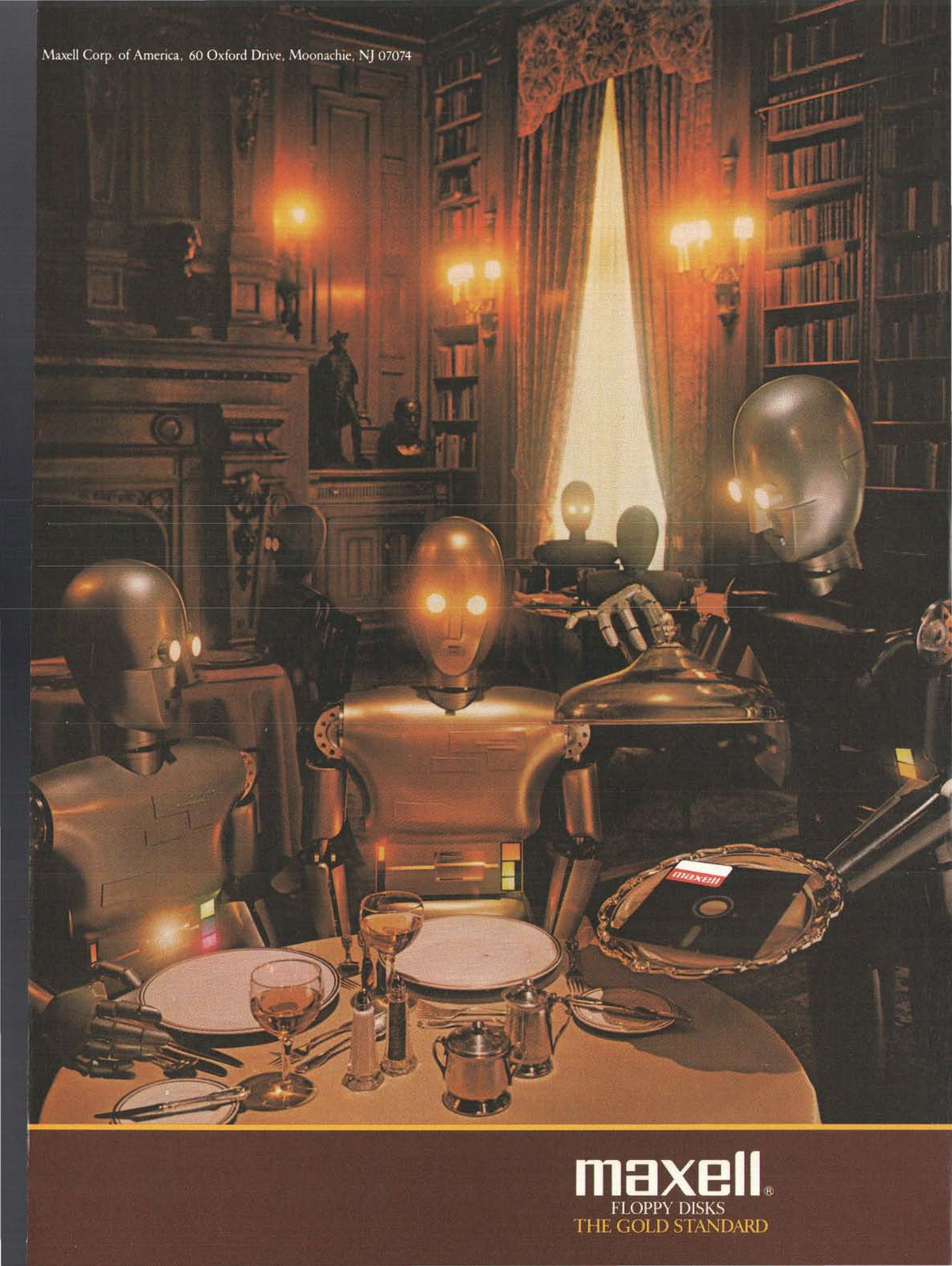
The variety of possibilities for data storage should allow us to get the most out of the Pyramid hardware. We'll begin with four 470-megabyte disk drives.

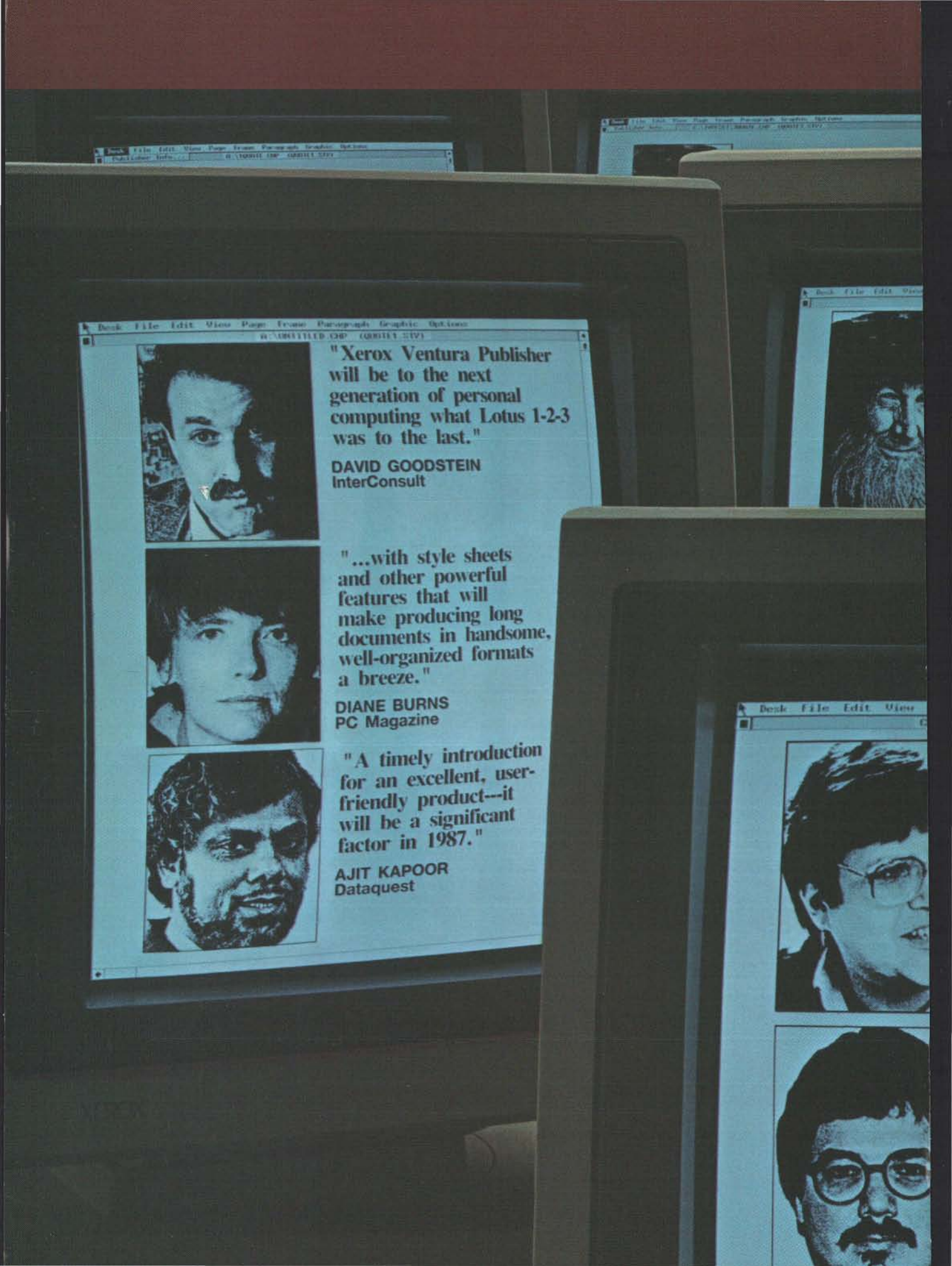
Summing Up

The Pyramid 9820 gives us enough computing power, ports, and X.25 virtual connections to support hundreds of simultaneous users and also to arrange data feeds for additional information products to be accessible to BIX users. We will be not only improving service for users of BIX conferences and the Microbytes news service, but also making the entire BIX environment richer.

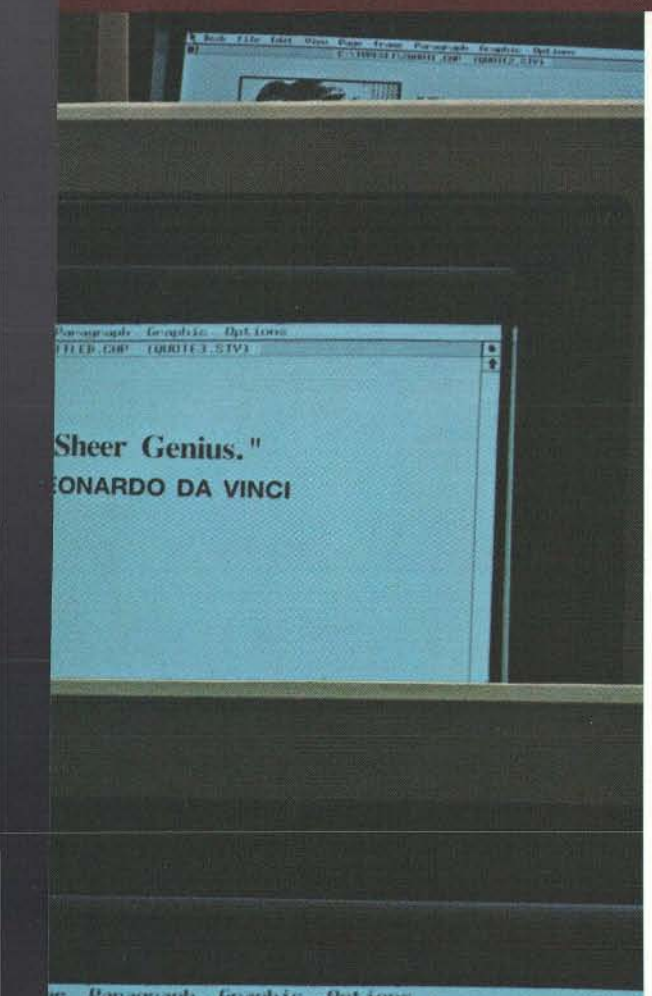
We are confident that the Pyramid 9820 architecture will provide a fine venue for sophisticated computer users all over the world to "meet" on-line for years to come. We look forward to seeing you there.

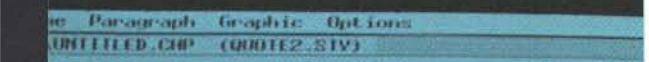
—Phil Lemmons
Editor in Chief
(BIX name: "plemmons")


Maxell Corp. of America, 60 Oxford Drive, Moonachie, NJ 07074
maxell
maxell®
FLOPPY DISKS
THE GOLD STANDARD


"Xerox Ventura Publisher will be to the next generation of personal computing what Lotus 1-2-3 was to the last."
DAVID GOODSTEIN
InterConsult
"...with style sheets and other powerful features that will make producing long documents in handsome, well-organized formats a breeze."
DIANE BURNS
PC Magazine
"A timely introduction for an excellent, user-friendly product---it will be a significant factor in 1987."
AJIT KAPOOR
Dataquest

XEROX





"This product could set the standard for desktop publishing. It's fast, it's fully featured, it allows you to do things never thought possible."

AMY WOHL
Wohl Associates

"Will set the standard of comparison in desktop publishing."

JAMES CAVUOTO
MicroPublishing

They raved about Version 1.0. Now read about Version 1.1.

Xerox Ventura Publisher, the easily mastered, industrial-strength publishing genius that runs on a standard IBM XT or AT, or compatible, just got better. Version 1.1 offers 80 significant enhancements for short document handling; text, graphics and font support; and broader output capability.

Xerox Ventura Publisher already gets raves for long documents; now Version 1.1 offers 20 additional features for producing short documents. There's automatic kerning, support for multicolumn frames, improved hyphenation, cropping and sizing of art, on-screen rulers, and automatic letter spacing, to name a few.

For documents of any length, page layout and type control have been raised from excellent to sensational. Pictures are now anchored to text during batch pagination. Documents up to 128 chapters in length, each containing 150 to 300 pages of text, are easily handled. The result is a desktop publishing package that can be judged by printing industry graphic standards.

To the longest list of text and graphics input support in desktop publishing comes even greater capability. Version 1.1 adds word processing interfaces for XyWrite, Displaywrite III and IV and DCA files. There's graphic conversion for more than 500 graphics packages based on a dozen file formats, including Macintosh "PICT" and image files. Plus downloaded PostScript fonts, conversion of H-P Soft-fonts and support for Adobe screen fonts.

This new release makes Xerox Ventura Publisher the first desktop publishing program to support the industry-standard page-description languages: PostScript and Interpress. That means total compatibility with all popular laser printers, including, of course, the Xerox 4045 Laser CP and the Xerox 4020 Color Ink-Jet Printer.

Team Xerox

Xerox Ventura Publisher 1.1—industrial-strength publishing genius that lets you do so much more, so much faster, ever so easily—right on the desktop.

Circle 302 on Reader Service Card

Xerox Corporation, P.O. Box 24, Rochester, NY 14692.
For more information about Xerox Ventura Publisher 1.1, stop by any computer store featuring Xerox software, contact your local Team Xerox sales office, or call 1-800-TEAM-XRX, ext. 213B.

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____
213B 192-10-87

XEROX® is a trademark of XEROX CORPORATION.

LETTERS

and Review Feedback

Enhancements to C-terp

I was extremely pleased by John Unger's favorable review of C-terp ("Four C Language Interpreters," June). His description of C-terp is accurate, and his understanding of the product is excellent.

I would like to update readers on Gimpel Software's C-terp 3.00. We have added numerous debugging features, including the dumping of aggregates such as structures and arrays, exposed macros, watch expression, watch condition, sticky breakpoints, temporary breakpoints, and a `leave function` command.

Gimpel Software has developed a new optional method of handling very large applications by having all C modules share the same external symbol table. In addition to saving on space, this option also speeds up compilation. Another enhancement is C-terp's ability to directly access extended memory through software paging. We now provide an automated system of adding commercial libraries by running a simple batch procedure. Also, a new configuration program lets users more easily customize C-terp to their personal programming habits and particular applications.

James F. Gimpel
President, Gimpel Software
Collegeville, PA

Of Mice and Mechanics

The review of computer mice by William H. Murray and Chris H. Pappas ("Pick of the Litter," June) was, in our opinion, not a thorough investigation of issues that are relevant to everyday use of the device. Specifically, we at the Torrington Company do not agree with the statements about our two-wheel direct drive tracking mechanism, nor do we believe them to be a concern of the typical user. It has been our experience that the two-wheel design works well on many different surfaces, both hard and soft, and we've received very few customer complaints regarding this issue.

Additionally, the reviewers made a statement about the trouble-free operation of optical versus mechanical mice because of the clogging associated with "wheels and balls." It was our recognition of this problem that led us to use the wheel design. We are sure that if the reviewers had sufficient time to thoroughly test this design compared to a traditional ball mouse, they would agree that it will not clog with normal use.

Finally, the statement regarding our Model 1001C-KF (and the Keyfree driver) is incorrect. Keyfree will not allow the user to "custom-design application-dependent pull-down menus." Instead, we provide a pop-up window to allow redefinition of mouse buttons while in the application program.

Mark J. Rossi
The Torrington Company
Torrington, CT

Updating Ada

I commend you and Namir Clement Shammas on the excellent comparative review of PC Ada compilers ("Ada Moves to Micros," July). Since the review appeared, Artek Ada has been greatly enhanced. the current version number is 1.30, and this new release now supports complete Ada tasking, generic objects, and all the features listed in table 1 on page 240 of the July issue. The Artek translator now handles all BYTE benchmark programs correctly, and, according to our tests, the compiler now performs better in the speed and executable file size benchmarks.

Artek Ada has been scheduled for official validation at the British National Computing Centre this autumn. We expect the certified Artek Ada 2.0 to be commercially available later this year. The price of the compiler will remain at $495. An upgrade from the previous versions will be available at a nominal charge.

Finally, we've moved, and our address is now Artek Corp., 835 East 25th Ave., Eugene, OR 97405. The local phone number is (503) 683-1265. Our toll-free number remains (800) 722-7835.

Vilhjalmur Thorsteinsson
Manager, Research and Development
Artek Corporation
Eugene, Or

Namir Clement Shammas states that Alsys Ada "dictates that you use the Profit board; it will not run without it, and it will not run with any other memory board." This is completely incorrect! Alsys Ada version 1.2 works with as little as 3 megabytes of memory from any memory board. You must set certain switches on the Alsys compiler, since it expects 4 megabytes, but it works well with 3 megabytes.

Also, although Alsys Ada requires compiling on an IBM PC AT, compiled programs will run on IBM PCs or compatibles. Thus, you can develop programs on an AT and port them for PC, XT, and AT users.

William H. Murray
Montrose, PA

Mac II Preview

I used to say that I subscribed to BYTE to read Jerry Pournelle's column. After a couple of readings of your April issue (specifically the product preview of the Apple Macintosh II), I have to add two names: Gregg Williams and Tom Thompson. Really, a great article.

The article, however, leaves an unanswered question. In which BYTE issue will we get a Macintosh II product review?

Thanks for a fine job.

David E. Goode
McLean, VA

Thank you. A review of the Macintosh II appears on page 197.

—Eds.

Noted with Interest

The articles in your May issue were interesting and informative—in particular, the features about desktop publishing.

I noted with regret, however, the lack of any discussion about Page Planner in the text of Thom Holmes's article, "Make My Page." We operate three Page Planner units in our shop and consider them to be excellent. Moreover, the new owners of the supplying company have an aggressive development program under

continued

LETTERS POLICY: *To be considered for publication, a letter must be typed double-spaced on one side of the paper and must include your name and address. Comments and ideas should be expressed as clearly and concisely as possible. Listings and tables may be printed along with a letter if they are short and legible.*

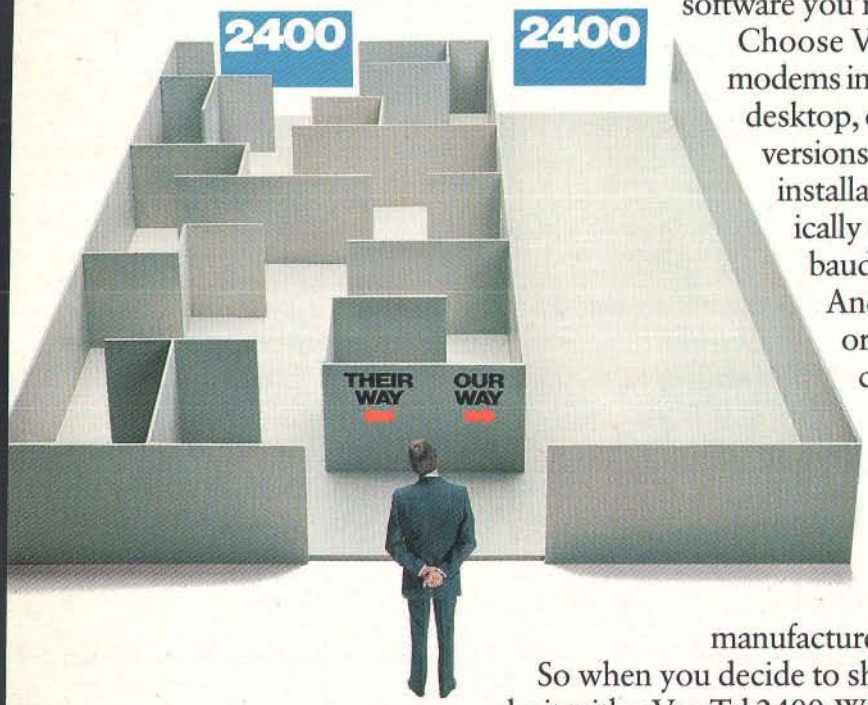
Because BYTE receives hundreds of letters each month, not all of them can be published. Letters cannot be returned to authors. Generally, it takes four months from the time BYTE receives a letter until it is published.

Ven-Tel clears the path to 2400 baud.

Trying to install a 2400 baud modem in your PC can make you feel like you're trying to get through a maze.

With most 2400 baud modems, you'll wade through pages of documentation... only to learn that you must set dozens of parameters and reconfigure your software. Even buy all new software.

Ven-Tel 2400 baud modems eliminate the barriers. Just plug one in, and you're ready to transmit your data twice as fast. Using whatever software you're using today.



Choose Ven-Tel 2400 baud modems in either our convenient desktop, or Half Card™ internal, versions. Each requires minimal installation and will automatically connect with 1200/300 baud modems and services. And each is available with or without X.PC error correction built-in.

Like all of our PC products, Ven-Tel 2400 baud modems are backed by a free *five-year* warranty. No other major manufacturer even comes close.

So when you decide to shift into high gear, do it with a Ven-Tel 2400. We give you the speed you want—without making you work for it.

Ven-Tel
Modems

Our free 24-page booklet, "How to Select The Correct Modem," contains specific information about our full line of Ven-Tel 1200 and 2400 baud modems. To request your copy, call 800-538-5121.

Circle 286 on Reader Service Card

way, and we are very pleased with the range of new products.

I draw this to your attention because we rely on your publication to be thorough, and to discover the "sleepers" for us. If we relied on Mr. Holmes's article while shopping for a microcomputer-based typesetter, we would have missed Page Planner, and that would have been a shame.

For many (if not most) applications, Page Planner can match Magnatype feature for feature—that is, in every way except price. With certain subroutines Magnatype is vastly superior, of course; with others, such as the Universal Conversion, Magnatype remains in the Stone Age in comparison. But again, Page Planner costs significantly less.

Paul Davies
Oakville, Ontario, Canada

Uniform vs. Nonuniform Distribution

I found "Building a Random-Number Generator" by Brian Wichmann and David Hill (March) interesting and useful. However, one of the statements in the article is confusing. The authors write, "It is clear that if $x1$ and $x2$ are independent and uniformly distributed, then the combination of $x1$ and $x2$ is also uniformly distributed over the same range of values."

You can refer to one of numerous textbooks devoted to the subject—for instance, *Probability, Random Variables, and Stochastic Processes* by Athanasios Papoulis (McGraw-Hill, 1965)—to be convinced that the authors' claim is not true. One of the fundamental properties of two random variables states that their combination (i.e., their sum) has its probability density function in the form of the convolution of the primary probability density functions. In the referred case, for $x1$ and $x2$ uniformly distributed over the range (0,1), the combination $x1+x2$ will be nonuniformly distributed (triangle-shaped) over the range (0,2).

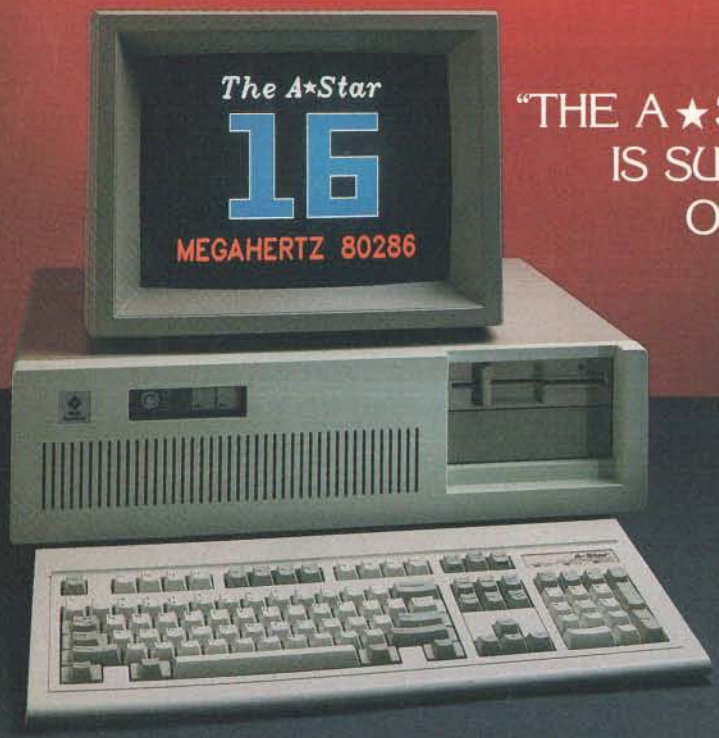
Roman A. Dyba
Rome, Italy

A Powerful Idea

Bill Gates's article, "Beyond Macro Processing," in the Summer *Applications Software Today* issue of BYTE, calls for a common application protocol that would provide a programmatic interface to the functions of multiple applications, to supplement the user interfaces for these functions. This would permit the creation of useful macro programs that combine and integrate the functions of several applications, using a standard macro language.

This is a powerful idea, and it is en-

continued



"THE A★STAR'S CPU PERFORMANCE IS SUBSTANTIALLY ABOVE THAT OF THE IBM PS/2 MODEL 60."
-INFOWORLD

NOW OS/2 COMPATIBLE

WHO CARES!

For about $5300, you could own an IBM PS/2 Model 60. But for as little as $1100, you could own a Wells American A★Star® that can outperform it. Of course, for nearly the same money as an A★Star, you could also own any number of Asian built no-name clones. But then you wouldn't be getting the exclusive ownership advantages that *only* the A★Star offers. Advantages like an 80286 CPU that runs the new MS OS/2 operating system and can also run at 6, 8, 10, 12, 14 and now...16 MHz! And you wouldn't be getting schematics. (Ours are free!) Or GE/RCA on-site maintenance. Or a no questions asked money-back guarantee. Oh, and there's one more little item you wouldn't get... peace of mind. Wells American has been making microcomputers longer than IBM! In fact, we've probably been making microcomputers longer than *anybody*!

But hey, who are we kidding? Not everyone cares about quality, reputation, support or serviceability. That's why there are mail-order houses. And, as hard as it is to believe, not everyone cares about money or performance. Maybe that's why there's IBM (and Compaq®...and all the others). But, for computer users who *do* care, there is, fortunately, a vendor who also cares...Wells American. And, we'd like to prove it to you. Call us with the page number of this ad. It's worth a big discount on your next A★Star computer system. Call today. 803/796-7800. This offer *is* limited.

Wells American®

Corporate Headquarters: 3243 Sunset Boulevard • West Columbia, South Carolina 29169 • 803/796-7800 • TWX 510-601-2645

couraging to see the head of a major software company advocate it in such convincing detail. But it is not an entirely new idea (in the mainframe and minicomputer arenas, IBM's Rexx and Exec2 languages and the various Unix shell languages are macro languages in Gates's sense), and it has some clear limitations.

Application commands sometimes have many relevant outcomes, each of which must be dealt with in the macro program. Too often, though, sophisticated pattern-matching is needed to distinguish these outcomes. This greatly complicates the task of writing nontrivial macro programs. Moreover, changes to the underlying applications can change both the outcomes and their distinguishing patterns, thus invalidating existing macro programs.

It is possible to overcome these problems by designing and maintaining application commands as if they were programming language statements or library subroutines, but this may be asking too much of application developers.

Chris Shaw
Manhattan Beach, CA

Contouring Comments

Paul D. Bourke's article and accompanying software code, "A Contouring Subroutine" (June), is a fine example of the kind of material that I believe is worthy of being published in BYTE. Bourke writes with clarity, and his descriptions are precise; this applies to both text and software.

About 12 years ago, as part of a commercial venture, I wrote a subroutine similar to Bourke's CONREC, and I agree with him that other, commercially available contouring subroutines are needlessly complex and computationally intensive. In my own subroutine, the common apex of the triangles whose planes intersect (or do not intersect) the plane of a specified contour level are the "centers of gravity" of groups of two, three, or four contiguous points. The professional geographer who reviewed my work objected that it was too simple a scheme to be of any real value.

I am less enthusiastic about William G. Hood's article, "Polynomial Curve Fitter," in the same issue. The article assumes that the user knows virtually nothing about the mathematical bases on which the curve-fitting algorithm is built, and this is glossed over in the article by superficial descriptions of the mathematics involved. This is an increasingly common treatment of programs using the techniques of numerical analysis, and there have been several descriptions in the literature of indiscriminate use of such routines as if they were universal tools.

Hood asserts that "the program . . . uses the orthogonal polynomial method," as if there were only one such method and as if there were only one form of orthogonal polynomial. In fact, with all weight factors equal to 1, Hood's scheme is nothing more than ordinary polynomial regression. In addition, there are numerous orthogonal polynomials, and these include the Fourier series (touched on lightly in Hood's article), which has the unique property of being dually orthogonal.

Hood also errs in limiting his description of Horner's rule for evaluating polynomials. The procedure requires n multiplications plus n additions for a total of $2n$ operations. For values of $n \leq 4$, Horner's rule requires the minimum possible number of arithmetic operations, but for polynomials of higher degree, there are schemes that require fewer than $2n$ operations.

I suppose it is natural that we "old fogies" of the precomputer generation should note that Horner's rule did not magically appear in the BASIC language, and that there are implementations of the rule other than the one presented in Hood's article. Using the more accepted form of Hood's polynomial; that is,

$$p(x)=c_0+c_1x+c_2x^2+ \ \ldots \ c_nx^n,$$

Horner's rule requires the forming of the nested arrangement,

$$p(x)=c_0+x(c_1+x(c_2+ \ \ldots \\ x(c_{n-1}+xc_n) \ \ldots \ ))$$

If the order of the terms on the right-hand side is reversed, the nested form can be more readily understood, and for a polynomial of degree 5 (for example) we get

$$p(x)=((((c_5x+c_4)x+c_3)x+c_2)x \\ +c_1)x+c_0$$

It should also be emphasized that the range of validity of the regressed polynomial expression is limited to the range of the empirical data; in Hood's example, $0.5<x<15.5$.

Clive J. Grant
Chichester, NH

Accurate Algorithm

I would like to offer some comments on Paul D. Bourke's interesting article, "A Contouring Subroutine," (June). The main strength of the algorithm Bourke presents (other than sheer simplicity) is its high degree of accuracy, especially in those cases where the data points are chosen judiciously. It will not produce intersecting contour lines, an anomoly

continued

often allowed by more "advanced" contouring packages in which each contour is smoothed independently of its neighbors. It also produces a more straightforward representation of edge discontinuities.

The problem of the lack of z-value information is actually worse than the article implies, however, as it is not possible to determine direction of slope or to distinguish between bumps and dents. In addition to the visual clues mentioned (color, line style, and contour labeling), I have found that viewpoints other than the vertical provide a depth clue readily apparent to most eyes, even without hidden-line removal.

A weakness not mentioned in the article is that contours drawn within one grid square are not influenced by nearby trends. For example, the algorithm will produce the same (incorrect) saddle shape for a grid element crossed by a ridge along one diagonal or by a valley along the other diagonal. This problem disappears when data points are spaced closely enough to minimize the out-of-plane warping of each grid element.

The CONREC subroutine operates on a grid formed by the intersection, at right angles, of two sets of irregularly spaced parallel lines.

Of course, quadrilaterals of extremely irregular shape should probably be handled more generally, perhaps by calculating the z value of the central point as an average weighted by the relative lengths of the diagonals. In addition, where the central point falls outside of the element, the shorter diagonal should be used to divide the quadrilateral into just two triangles.

In any case, it seems futile to resolve the results calculated on a typical finite element mesh, in which element sizes often vary widely, onto a regularly spaced grid for the sole purpose of producing a contour plot. In addition, contour-smoothing algorithms are based on interpolation techniques that bear no relationship to the laws actually governing the behavior of the structure being analyzed.

While the mathematics of the algorithm itself are quite simple, I found Mr. Bourke's implementation unnecessarily complicated. Each triangle is classified according to the relative positions of each of its vertices below, coincident with, or above each contour plane. A simpler approach uses these three rules:

Rule 1. If the number of contour planes below each vertex of a triangle is the same, the triangle is not intersected by any of them.

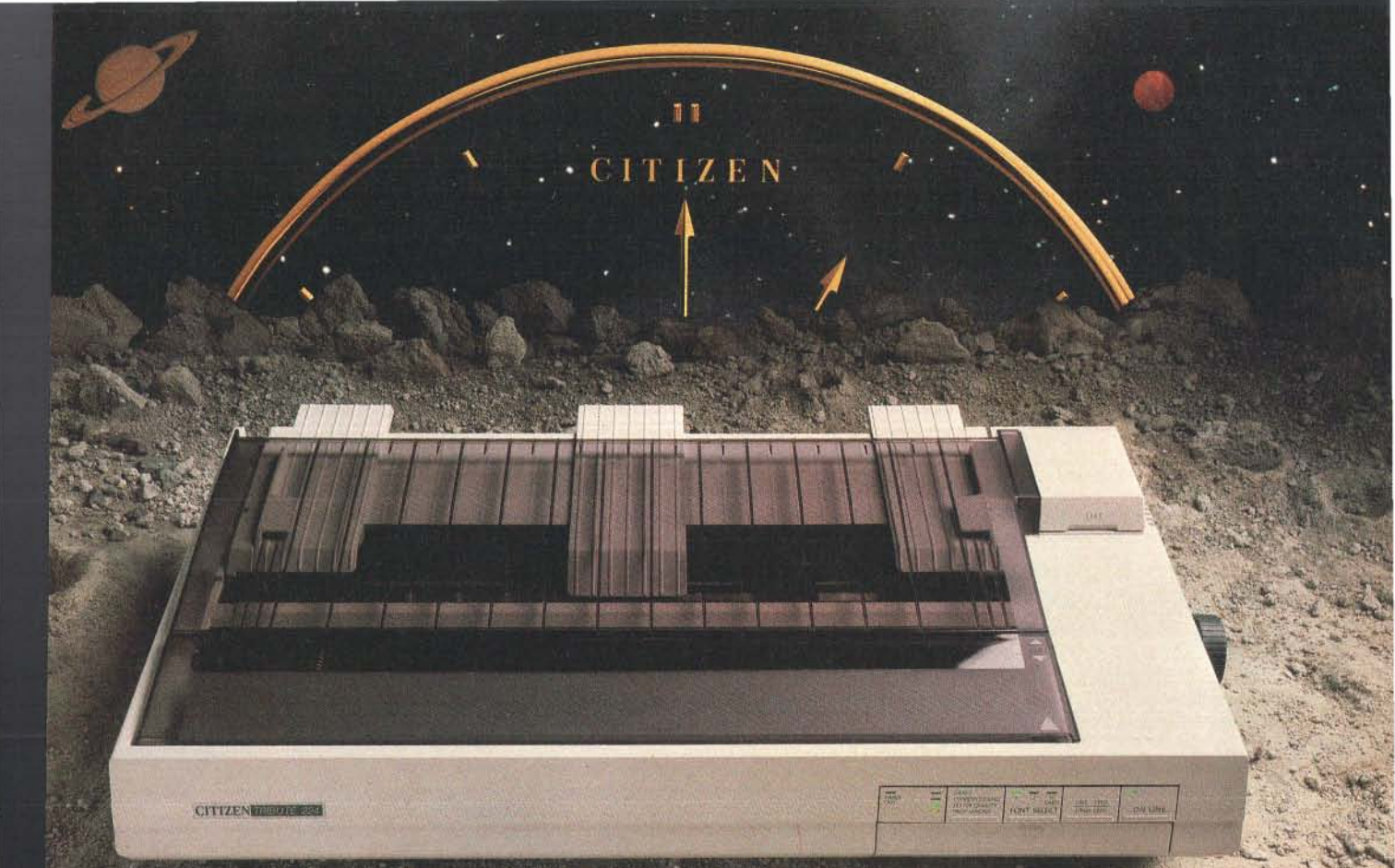
Rule 2. If a triangle is intersected by any contour planes, then at least one of its sides will be intersected by each of the resulting contour lines, and this side will be one that connects vertices having the minimum and maximum z coordinates.

Rule 3. Each contour line will also intersect one of the two remaining sides, depending on whether its z coordinate is less than that of the third vertex.

Note that if two vertices have an identical z coordinate, then either of the two sides qualifying under Rule 2 can be chosen with no adverse results. Coding this approach is further simplified by the fact that only two cases are considered, and if contours are processed in order of z coordinate, all of one type (i.e., below the third vertex) are calculated before any of the other type. Mr. Bourke's various triangle classification schemes are handled properly, but without having to consider them as special cases:

1. All vertices below or above a given contour plane: This plane is not considered with respect to this triangle (rule 1).

continued



A TRIBUTE TO THE 24-PIN PRINTER.

You're looking at all the printer you'll ever need. For any application you'll ever have.

The Citizen™ Tribute™ 224. A 24-pin dot matrix solution offering superb word processing, spreadsheet, graphics and data processing applications. At a price you'll find surprisingly affordable.

The Tribute 224 delivers true letter-quality printing at 66 cps, correspondence-quality at 132 cps, and drafts at 200 cps (at 10 cpi). In standard or proportional spacing. And optional IC cards enable fonts and emulations to be easily expanded.

You also get high-resolution graphics. A built-in, push-feed, variable-width tractor and automatic paper loading system. Both serial and parallel interfaces for flexible hardware compatibility. Front panel access to most print functions. And compatibility with virtually every major software package.

All this, and it's backed by our nationwide service, excellent documentation, and 12-month warranty.

For more information, call 1-800-556-1234, Extension 34. In California, call 1-800-441-2345, Extension 34.

The Citizen Tribute 224.
There is no higher tribute to 24-pin printing.

CITIZEN™
Printers that run like clockwork.

This ad is for people who don't know where to find Smalltalk. Or why.

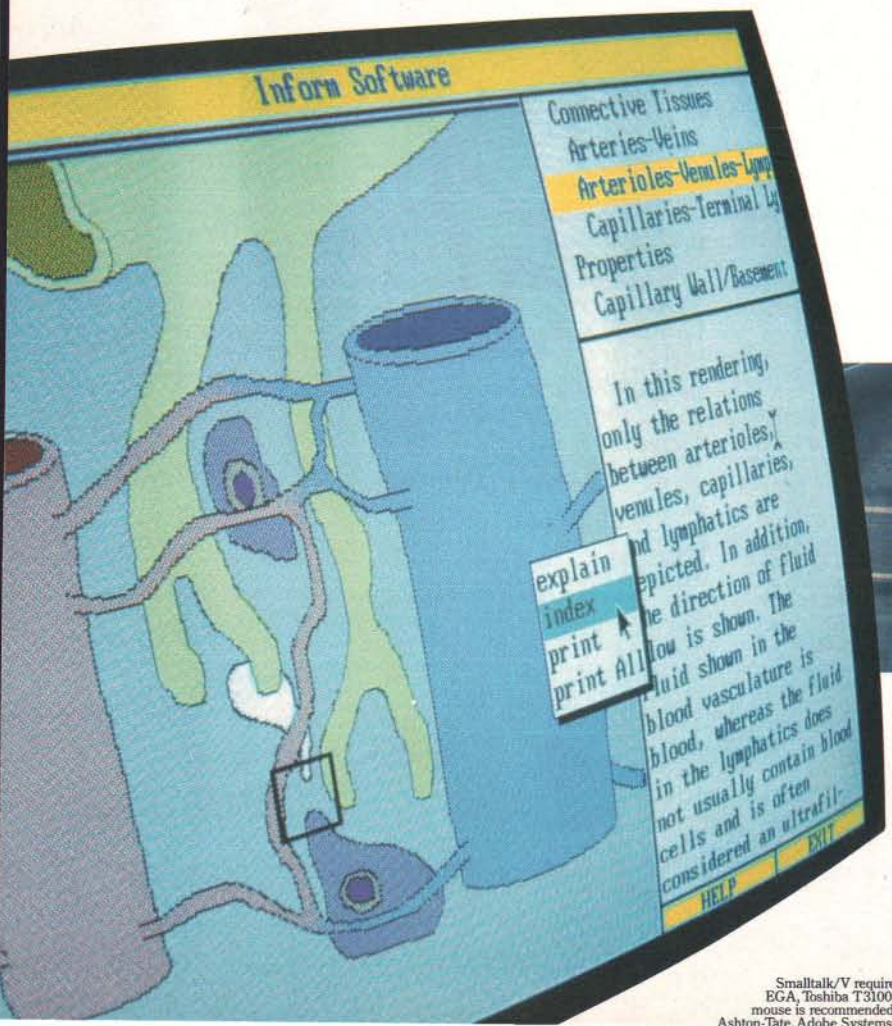
Today, the single most important emerging software technology is OOPS, object-oriented programming. It's destined to dramatically change the way you use your personal computer. You'll find it doing things you never expected. And by people you never suspected.

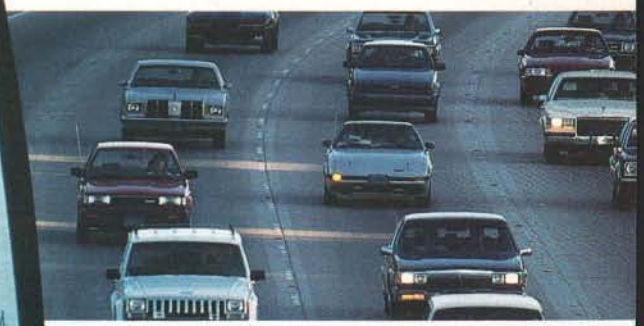
In an emergency room in Vancouver, it's saving lives through animation.

What if a medical textbook could come to life? What if it could show the effects emergency treatment might have on patients? And do it all through moving pictures? These thoughts led Folkstone Design, Edge Training & Consulting, and Inform Software in Vancouver, B.C., to create the first animated, interactive textbook for emergency room technicians and in-training paramedics. They found Smalltalk/V could easily facilitate a combination of text, color graphics and animation to illustrate various physical processes and the results of medical intervention.

At the UCLA Medical Center, it sees patients before the doctor does.

Mike McCoy, M.D., at the UCLA Medical Center, found that he could easily interface Smalltalk/V with dBASEIII and PostScript. His application, now in use at the Clinic, turns a functional status questionnaire on each new patient into a laser printed, advisary analysis for the doctor to review prior to seeing the patient. A program like this would normally take a specialist months to produce. It took Dr. McCoy less than 100 hours with Smalltalk/V.





It's working on Florida's freeways.

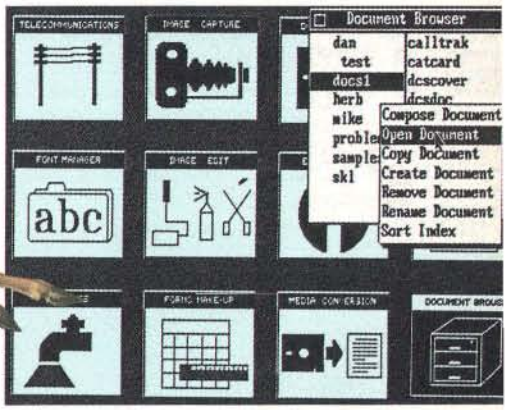
Running on IBM's new PS/2, a Smalltalk/V application developed by Greiner Engineering's Mike Rice, lets highway engineers create highly sophisticated graphic analyses of any proposed reconstruction. So now, instead of having to deal with a gridlock of Federal and State regulations, engineering specifications and endless calculations, an engineer can quickly explore alternative design strategies using a mouse, windows and VGA color graphics.

Smalltalk/V requires DOS and 512K RAM on IBM PC/AT/PS or compatibles and a CGA, EGA, Toshiba T3100, Hercules, or AT&T 6300 graphic controller. A Microsoft or compatible mouse is recommended. Not copy protected. dBASEIII, PostScript and PS/2 are trademarks of Ashton-Tate, Adobe Systems and International Business Machines Corporation respectively.

You can find it in space.

On a project commissioned by NASA, Dr. Christine Mitchell at the Georgia Institute of Technology, chose to use Smalltalk/V as an integral part of a new man-machine interface. The application, written in Smalltalk, continually monitors the commands of the Satellite Network Operator, the state-of-the-network and the overall mission plans.

To NASA, Smalltalk/V means real-time. Real OOPS. Real results.



It's tracking white-tail deer on the Barrier Islands of Georgia.

Dr. Lee Graham, a National Park Service ecologist chose Smalltalk/V to write an application to help manage the white-tail deer population on the Barrier Islands of Georgia. Dr. Graham found that Smalltalk/V, with its visual interface and class structure, is a perfect tool to graphically simulate the complex, ecological interactions of natural systems.

It's making headlines in Arizona.

When Digital Composition Systems sat down to build an electronic typesetting system, they had three major requirements. It had to have the most advanced user interface. It had to be fast. And, it had to be able to turn untrained personnel into high quality typographers. Of all the languages in the world, they chose Smalltalk/V. The result is the Signature Series, recognized and reviewed by The Seybold Report. It's now marketed by Digital Composition Systems and one of the largest digital typesetting firms in the world, Varityper AM International.

What thousands of people have found is OOPS.

Object-Oriented Programming (OOPS) is programming by defining objects, their inter-relationships and their behavior. Objects can represent both real-world entities like people, places, or things. They can also represent useful abstractions such as stacks, sets and rectangles.

OOPS models the way you think and the way things really are. It lets you solve problems by breaking them down into easily handled sub-problems and their inter-relationships. The solutions you come up with can be re-used to solve new problems. Ultimately, OOPS makes programming a simple, logical process of building on the work of others.

Why thousands more are finding their way to Smalltalk/V.

First of all, Smalltalk/V makes OOPS easy.

It's also fast. In fact, it's the fastest OOPS programming available on a PC.

And it's easy to learn. It comes complete with a tutorial that's the best introduction to OOPS available.

Smalltalk/V also has a few other features worth noting. Like a user-extendable, open ended environment. Source code with browser windows for easy access and modification. A huge toolkit of classes and objects for building a variety of applications. A sophisticated source-level debugger. Object-oriented Prolog integrated with the Smalltalk environment. And bit-mapped graphics with bit and form editors, just to name a few.

Then, there's its unbelievable price of only $99.95. (Optional application packs at $49.95 include Communications, EGA/VGA Color and Goodies.)

And it has a 60 day, money-back guarantee.

With all this to offer, it probably won't come as a surprise to you that more people are solving more problems with Smalltalk/V than any other OOPS.

See your nearest dealer today for your own Smalltalk/V. Or, order it direct with MasterCard or Visa at (800) 922-8255.

Or, write to Digitalk, Inc., 9841 Airport Blvd., Los Angeles, CA 90045. Then discover all the great things you can do with your PC and Smalltalk/V.

Smalltalk/V

digitalk inc.

*Now that you've found us, write us. Tell us some of the great things you're doing with Smalltalk/V. You could be in our next ad.

Circle 81 on Reader Service Card.

2. All vertices coincident with the given contour plane: No contours cross this triangle (rule 1).
3. Vertex *a* coincident with the contour plane, with *b* and *c* both above or both below: A zero-length line is drawn at *a*.
4. Vertices *a* and *b* coincident with the contour plane: A line is drawn beside *ab*.
5. Vertex *a* below the contour plane, and vertices *b* and *c* above (or the reverse): A line is drawn connecting sides *ab* and *ac*.
6. Vertex *a* above the contour plane, *b* below, and *c* coincident: A line is drawn from a point on line *ab* to vertex *c* (which can be assumed to belong either to side *ac* or to side *bc* with no change in result).

Al Dunbar
Edmonton, Alberta, Canada

Evaluating Benchmarks

In "The New Generation: High-Tech Horsepower" (July), a benchmark comparison between the iAPX386 and the MC68020, you took pains to explain that benchmarks, especially those written in high-level code and that run on off-the-shelf machines, present a can-of-worms problem and are likely to be misleading in that they test the compiler and the whole system perhaps more than the central processor itself. Without quoting figures from my own experimentation and analysis, I would like to point out that the results you presented at the end of the article are indeed misleading, just as you hint they may be.

The choice of systems on which to perform the tests is fair to neither CPU, and disproportionately so. A Sun-3 system and Sun's compiler would make vastly better use of the 68020; systems and compilers yet to be developed using the 80386 would do more justice to it.

The only way to obtain a valid comparison between anything is to isolate the objects in question from all other factors, removing unrelated variables from the equation. To realistically compare the 80386 to the 68020, experts for each system would have to hand-optimize the code for each benchmark, then run the test on a system designed to perform at the maximum possible speed for each chip, under the stated conditions (i.e., floating-point processor or not, memory management or not, and so forth), and run each test to its completion rather than extrapolating from a subsample.

To date, all published "benchmark" tests I have seen concerning these two CPU chips, yours included, fail to isolate the variables under test from the noise, and therefore they say little or nothing about the actual performance of the CPUs in question.

Ian H. Merritt
Oxnard, CA

The July article entitled "The New Generation: High-Tech Horsepower" gives a very misleading impression of floating-point performance on the Macintosh.

The confusion arises because you have naively used double variables in your tests; the more accurate 80-bit extended format is the natural format for the SANE floating-point package. I believe double and single variables are supported only to enable data transfer to other computers that use these formats. All computations should be done using extended variables; otherwise, the computer spends an enormous amount of time converting to and from different floating-point formats because all internal computations are done in extended format.

For example, your Float test in Tom M. Leonard Pascal version 2.01 takes 126 seconds on my humble Mac Plus using extended variables in extended precision, while it takes an amazing 276 seconds using double variables in double precision.

Using a good C compiler on a Mac SE

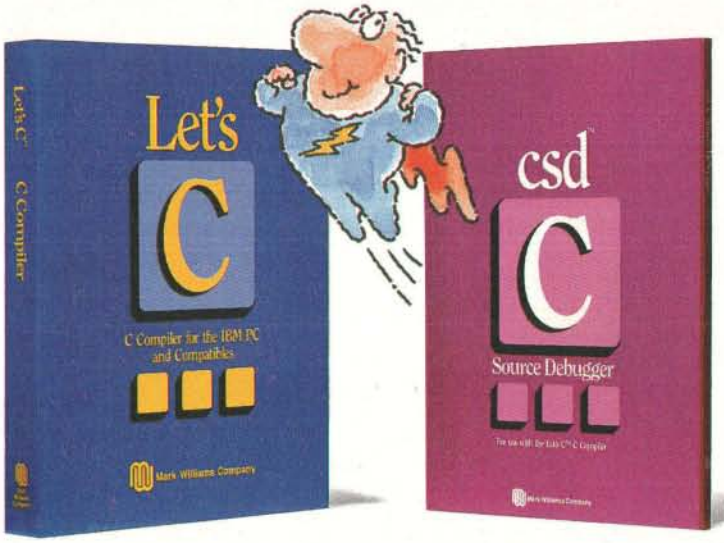
continued

PRESENTING THE DIFFERENCE BETWEEN FAST COMPILING AND FAST PROGRAMMING.

For compiling speed, you can't do better than Let's C. But to really speed up programming you can't do without the powerful source level debugger, *csd*.

If you want the power, portability and flexibility of C, start with the complete compiler, Let's C. For utilities, editor, compiling speed and fast, dense code, Let's C has it all.

But to get your programs up and running you need more. Because even the fastest compiler can't outrun bugs. You need the revolutionary C Source Debugger, *csd*.



CUT DEVELOPMENT TIME IN HALF WITH *csd*

csd lets you bypass the time consuming frustrations of debugging–like long dumps and clunky assembler. With *csd*, you actually debug in C. You learn faster because you watch your program run in C. You finish faster because *csd* combines the speed of a compiler with the interactive advantages of an interpreter. The end result? Development time is sliced in half.

LIMITED TIME OFFER FREE *csd* WITH LET'S C!

LET'S C AND *csd* FEATURES

NEW VERSION 4.0!

Let's C:

- Now compiles twice as fast
- Integrated edit-compile cycle: editor automatically points to errors
- Includes both small and large memory model
- Integrated environment or command line interface
- 8087 sensing and support
- Documentation features new lexicon format
- MS-DOS object compatible
- New make utility
- Fast compact code plus register variables
- Full Kernighan & Ritchie C and extensions
- Full UNIX compatibility and complete libraries
- Many powerful utilities including make, assembler, archiver, cc one-step compiling, egrep, pr, tail, wc
- MicroEMACS full screen editor with source included
- Supported by dozens of third party libraries
- For the IBM-PC and Compatibles
- Not copy protected

Sieve Benchmark

(Compile time in seconds)
Let's C: **2.8** (On 512K 6Mhz IBM-AT)
Turbo C: **3.89** (As advertised)

csd:

- Large and small memory model
- Debug in C source code, not assembler
- Monitor variables while tracing program
- Does not change program speed or size
- Provides separate source, evaluation, program and history windows
- On-line help screens
- Can interactively evaluate any C expression
- Can execute any C function in your program
- Trace back function
- Ability to set trace points
- Not copy protected

REVIEWERS ARE RAVING ABOUT LET'S C AND *csd*.

"Let's C is an inexpensive, high-quality programming package... with all the tools you will need to create applications."
–William G. Wong, *BYTE*, August 1986.

"The performance and documentation of the $75 Let's C compiler rival those of C compilers for the PC currently being sold for $500...highly recommended..."
–Marty Franz, *PC TECH JOURNAL*, August 1986.

"csd *is close to the ideal debugging environment...a definite aid to learning C and an indispensable tool for program development."*
–William G. Wong, *BYTE*, August 1986.

"This is a powerful and sophisticated debugger built on a well-designed, 'serious' compiler."
–Jonathon Sachs, *Micro/Systems Journal*, April, 1986

START TO FINISH, THERE'S NO BETTER ENVIRONMENT.

Get started with the right C compiler and you'll have everything you need for development–including source level debugging. On top of it all, Let's C and *csd* are today's best values in professional C programming tools. And most reliable: Mark Williams C compilers have been sold with DEC, Intel and Wang computers since 1981.

60 DAY MONEY BACK GUARANTEE

Mark Williams gives you a full 60 days to find out just how good Let's C and *csd* really are–or your money back.

So if you want more than a fast compiler–if you want your programs up and running fast, ask for Let's C and *csd*. You'll find them at your software dealer's, in the software department of your favorite bookstore, through the Express Program at over 5500 Radio Shacks or you can order now by calling **1-800-MWC-1700.***

*In Illinois call, 1-312-472-6659.

Mark Williams Company
1430 West Wrightwood, Chicago, Illinois 60614

MARK WILLIAMS LET'S C AND *csd*. ONLY $75 EACH.

with extended variables, you will comfortably out-perform an IBM PC AT without floating-point unit and be more accurate at the same time.

I hope you will publish the list of benchmark results again, but this time using extended variables on the Mac. I do not believe it is performing any trick against the spirit of benchmarking to artificially boost the performance of the Mac. After all, you are requiring greater accuracy and simply using the format it was designed for, and using double variables artificially degrades its performance. Also, I suspect that floating-point software for the other computers is designed for double variables.

K. D. Watling
Swansea, Wales

I would like to make two suggestions that would enhance the value of future 32-bit benchmarks. The first regards 32-bit versus 16-bit benchmarks; the second, register variables.

I believe that the benchmarks for 32-bit processors should be written primarily to test 32-bit operations. Applied to "The New Generation: High-Tech Horsepower" article, the Fibonacci test (listing 1) should generate the largest Fibonacci number that will fit in 32 bits (or one bigger than 16 bits). The Sieve of Eratosthenes (listing 3) should find all primes up to at least 100,000 and use a flag array well in excess of 64K bytes. The Quicksort test (listing 4) should sort at least 64,000 numbers.

These changes are important when benchmarking the 80386 because it performs differently in 16- and 32-bit modes; only with suitable benchmarks can we be sure that the results are representative of 32-bit applications.

The changes I have suggested are also important when comparing the 80286 and the 68000 with the 80386 and the 68020. Sixteen-bit processors (80286) will run the benchmark slowly or not at all, while 32-bit processors (68020, 80386, and 68000) will show their true performance.

About register variables: When benchmarking its processors, Motorola would like you to declare all character, integer, long, and pointer variables as register variables, since registers are a major feature of Motorola's architecture. In contrast, Intel would like you to avoid all register variables when benchmarking, because registers are *not* a major feature of Intel's architecture.

Rather than yield to either pressure group, I believe that you should perform the benchmarks both with and without register variables, publish the values, and let the readers decide whether they will use register variables in their application programs.

E. Stanbury
Lakemba, Australia

Applauding Ada

It is unfortunate that Joel West's book review of *The World of Programming Languages* (June) was filled with anti-Ada propaganda. Ada is a registered trademark of the U.S. Government (Ada Joint Program Office). Mr. West applauds Modula-2 for having extensible data types, yet he fails to mention that Ada does, too. He criticizes Ada for not having spawned another language. That is a strength, not a weakness. Ada is complete; substitutions are not needed.

Mr. West did say nice things about Pascal. But he failed to say that Ada is based on Pascal. He claims that Ada is a "huge language." Not true. It has only 63 reserved words. COBOL, the world's most popular language, has almost 500.

Mr. West was upset that C was not covered more thoroughly in the book. That is because C is nothing more than

continued

VRROOOM.

INTRODUCING FAST FORWARD.™
NOW ANY SOFTWARE CAN RUN UP TO 10 TIMES FASTER.

No more doodling while your database goes digging. Or lollygagging while your spreadsheet loads. Or taking five while your word processing program takes forever.

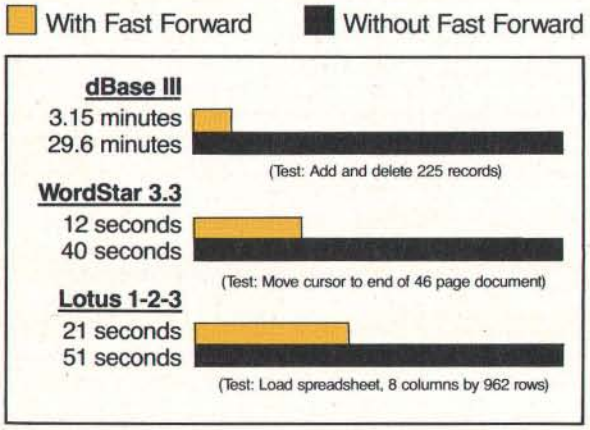
With Fast Forward, any software runs 2 to 10 times faster.

CAN SOFTWARE REALLY DO THAT TO SOFTWARE?

Fast Forward can. Normally, your computer is constantly going to your disk and wading through massive amounts of data.

But with Fast Forward, data is retained in your computer's internal memory. Which is incredibly fast. Much faster than hard disks. Hundreds of times faster than floppies.

FAST FORWARD PERFORMANCE



All tests done on 640K IBM PC, 20 megabyte hard disk and floppy drive. 320K RAM allocated to Fast Forward.

THE MORE YOU USE IT, THE FASTER YOU GO.

Once installed, Fast Forward works invisibly. As you use data, it's automatically stored in your computer's memory–and instantly available the next time you need it. Programs requiring frequent disk access (like dBase III) will show amazing improvements. And adding extended memory gives Fast Forward more room to work. So software runs even faster.

PERFORMANCE HAS A NEW PRICE: $69.95.

You can buy a faster computer. Or an expensive accelerator board. But if you're ready to turn on the speed without turning over a bundle of money, ask for Fast Forward. It's from the Mark Williams Company, makers of quality software tools since 1976. And it's available at your software dealer. In the software department of your favorite bookstore. Or by calling 1-800-MWC-1700.* And hurry. Because it'll be going fast.

*In Illinois: (312) 472-6659

60-DAY MONEY-BACK GUARANTEE

Mark Williams Company
1430 West Wrightwood
Chicago, Illinois 60614

Fast Forward runs on IBM-PCs and 100% compatibles. Not copy protected.

warmed-over PDP-11 assembly language. Ada was designed with these overriding concerns: efficiency, program reliability and maintenance, and programming as a human activity. I have used Ada for several years. I think that it is elegant, well-designed, and fun.

Mark Fowler
Huntington Beach, CA

Calculating Pi

John T. Godfrey's letter (May, page 20) describes a very clever algorithm for computing pi by means of calculating the perimeter of the inscribed/circumbscribed regular polygons of 2^n sides. While his version of this algorithm is very cleverly formulated, using *ratios* of successive circumferences as it does, the basic idea is, as he suspects, not new. In fact, it is due to the genius of Archimedes, who used it over 2000 years ago to obtain estimates of pi correct to three decimal places. This is doubly remarkable since the mathematics of Archimedes's time did not have the algebraic or decimal notation that we now enjoy.

One of the reasons this algorithm is not used very often is that it neither uses calculus nor is particularly fast in its convergence. Therefore, it is not taught in calculus courses, nor is it used in research-level pi calculations. Perhaps the most rapidly converging *series* for pi is the following, due to S. Ramanujan:

$$\frac{1}{\pi} = \frac{\sqrt{8}}{9801} \sum_{n=0}^{\infty} \frac{(4n)!}{(n!)^4} \frac{(1103+26390n)}{396^{4n}}$$

At the moment, the most rapidly convergent method of calculating pi is not by series, but by an iterative method using Gauss's arithmetic-geometric mean. The method is due to J. M. Borwein and P. B. Borwein (*SIAM Review* 26, 1984, pages 351–366, and *BIT* 26, 1986, pages 123–126). A nice discussion can also be found in *The College Mathematic Journal* (May 1987, pages 230–235).

Mark Bridger
Boston, MA

John T. Godfrey's letter on a formula for pi (May) is more accurate than the formula I derived, but it is based on the same principle. Mine may be easier to do on a hand calculator, however, because only one variable is used.

Starting with a 0, add 2 and take the square root. Keep adding 2 and taking the square root for the desired number of iterations, but on the last one subtract the number from 2. Multiply the result by 2 to the nth power, where n equals the number of iterations. On my Hewlett-Packard 11C, the answer for $n=8$ is within 0.0007 percent of the true value. For $n>8$, the answer is less accurate due to round-off error.

Frank J. Wilson
Mill Valley, CA

FIXES

Hidden Flaw

BIX now contains an article by Peter J. Becker called "Writing Interrupt Service Routines for the IBM PC in Turbo Pascal." It corrects one shortcoming in the article "Concurrent Programming in Turbo Pascal" by Mukkai S. Krishnamoorthy and Snorri Agnarsson (April). The techniques in the latter article are valid, but the implementation of an interrupt-driven tick counter in listing 8a (on page 133 of the April issue) has a hidden flaw: It crashes the IBM PC if you interrupt the main program with a Control-C. The BIX article shows how to correct this shortcoming and further explores the topic of running interrupt-service routines from Turbo Pascal. ■

2 new monitors for the System/2™.

2 good to be true.

Some people shy away from technological change. But at Amdek®, we look upon change as an opportunity.

And now that there's a new generation of PC's, we have the opportunity to introduce you to 2 new monitors from Amdek—the 732 color and 432 monochrome.

The meticulous details.

From the beautifully styled cabinet to the flicker-free screen, these new monitors are unmistakably Amdek.

Text so sharp, you'll think your newspaper is blurry by comparison. Graphics so colorful, you'll have a tough time trying to think of a hue you can't incorporate.

And because the Amdek 732 and 432 are compatible with IBM®'s new Personal System/2™ Video Graphics Array (VGA) and MultiColor Graphics Array (MCGA), the image of all your programs will look better than you've ever imagined.

The 732 allows you to choose from a palette of over 256,000 colors—up to 256 colors at once. And the text switch delivers clear single color text for word processing.

The black and white of it.

For the ultimate in monochrome, the 432 features a large 14-inch flat surface screen that projects visually larger black type against a high-contrast white phosphor background. The impression is more like ink on paper.

Combine these features with our non-glare screen and tilt/swivel stand, and you'll see that Amdek has thought of everything.

Then compare our monitor price against other monitors compatible with the System/2.

We think you'll enjoy that benefit, 2.

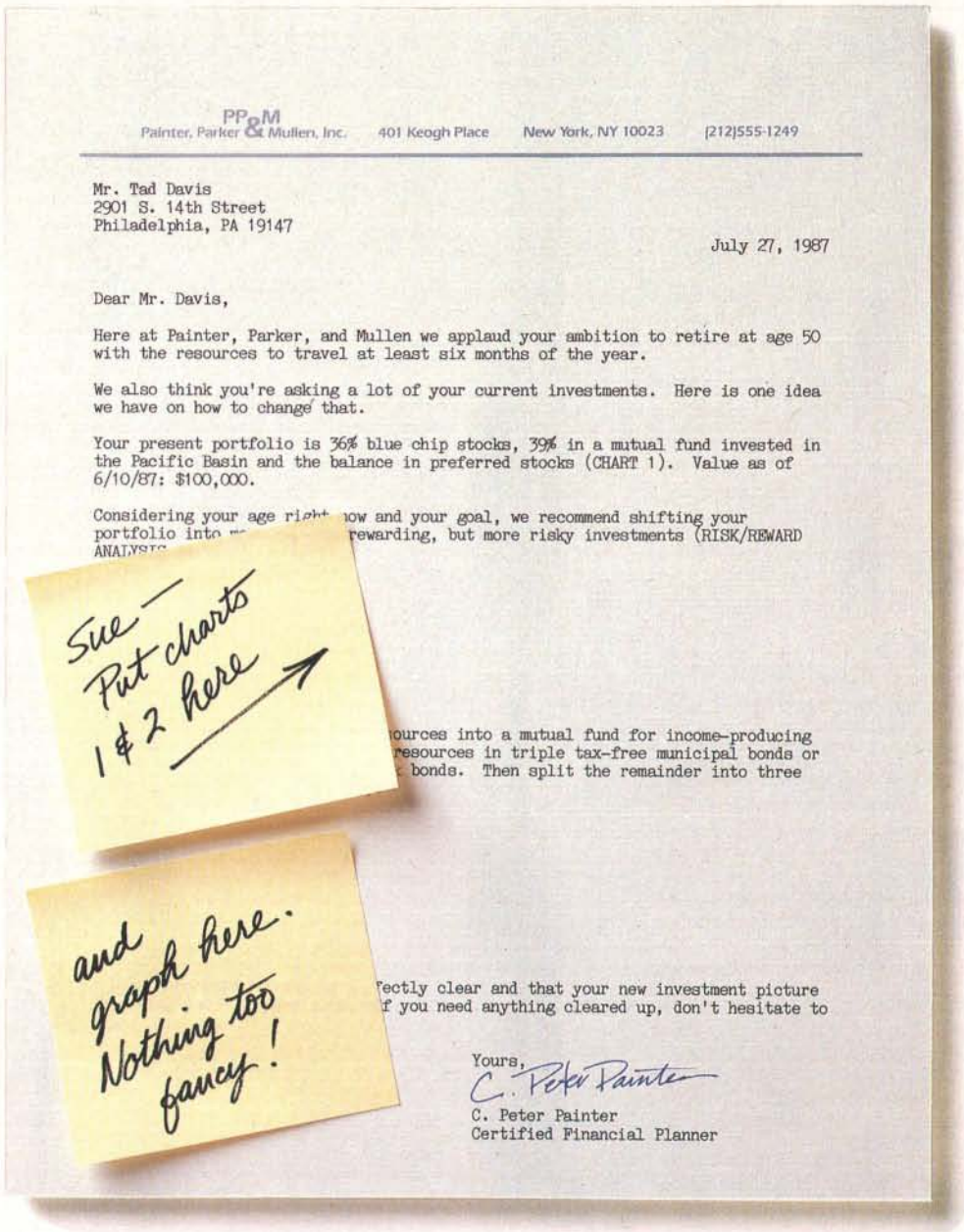
AMDEK

Clearly the finest in monitors.

1901 Zanker Road, San Jose, CA 95112 Phone: 800/PC-AMDEK (800/722-6335) FAX: 408/436-8187

Circle 13 on Reader Service Card

While the DAISYWHEEL shoots blanks...



PP&M
Painter, Parker & Mullen, Inc. 401 Keogh Place New York, NY 10023 (212)555-1249

Mr. Tad Davis
2901 S. 14th Street
Philadelphia, PA 19147

July 27, 1987

Dear Mr. Davis,

Here at Painter, Parker, and Mullen we applaud your ambition to retire at age 50 with the resources to travel at least six months of the year.

We also think you're asking a lot of your current investments. Here is one idea we have on how to change that.

Your present portfolio is 36% blue chip stocks, 39% in a mutual fund invested in the Pacific Basin and the balance in preferred stocks (CHART 1). Value as of 6/10/87: $100,000.

Considering your age right ow and your goal, we recommend shifting your portfolio into m rewarding, but more risky investments (RISK/REWARD ANALYSIS

ources into a mutual fund for income-producing resources in triple tax-free municipal bonds or bonds. Then split the remainder into three

fectly clear and that your new investment picture f you need anything cleared up, don't hesitate to

Yours,
C. Peter Painter

C. Peter Painter
Certified Financial Planner

Sue — Put charts 1 & 2 here →

and graph here. Nothing too fancy!

...the OKIDATA LASER hits the mark.

BULLSEYE INVESTMENTS

Mr. Tad Davis
2901 S. 14th Street
Philadelphia, PA. 19147

July 27, 1987

Dear Mr. Davis,

At Bullseye Investments drawing a brighter investment picture doesn't mean doing it "by the numbers." Sometimes you have to take risks. Take your goal of retirement at age 50. It's ambitious, but it's possible.

Your assets and investments as of 6-10-87, were about $100,000. Considering your dream, we recommend the following adjustments:

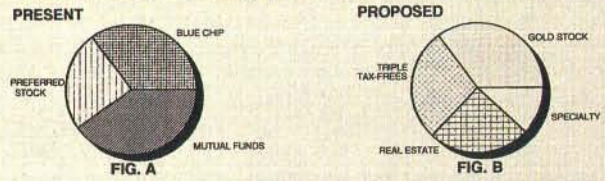


FIG. A FIG. B

Shift your money from blue chips, preferred stocks and mutual funds (FIG.A) *and into real estate, triple tax-free municipal bonds, specialized mutual funds and gold stocks.*(FIG.B)

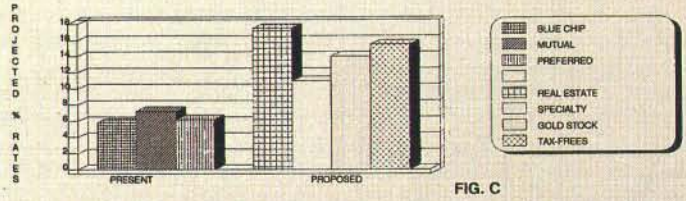


FIG. C

Naturally, your risks are greater. However, so are your rewards. Roughly 300% more interest and appreciation.(FIG.C) I'll call soon to review your portfolio in detail.

Yours,
William C. Ricci
Certified Financial Planner

1040 Archer Road ☐ Target, PA 17070 ☐ (717) 828-5555

With a daisywheel you waste a lot of time plugging the holes in your ideas.

But with the new LASERLINE™6 from OKIDATA you can grab your reader's attention right away.

Make your letters more effective by using graphics. Call attention to your hot topics with 15 built-in type fonts. And add emphasis to your most important ideas with underlining, boldfacing and italicizing.

Thanks to the LaserControl™ disc you get with it, you can do it all using software that's probably sitting next to your PC right now.

The OKIDATA LASER is compatible with LaserJet® and LaserJet Plus® software. And it's very affordable. You can own it for about what you'd pay for a good daisywheel. Get the three-user module and you've got economy no daisywheel can match.

So see your OKIDATA dealer today. Or call 1-800-OKIDATA, Ext. 22, for the name of the dealer nearest you.

Stop shooting blanks and start hitting the mark with an OKIDATA LASER.

OKIDATA®
an OKI AMERICA company

We put business on paper.

CHAOS MANOR MAIL

Conducted by Jerry Pournelle

Letter from Europe

Dear Jerry,

Right now, I am trying to decide just how badly I want (or need) to access BIX and other U.S. public networks. Would you like to know how much the Bundespost charges for transatlantic data traffic? I could really eat up my paycheck if I get a modem (charges) and an account on the German Datex-P network (charges) and move data (more charges).

People need information in order to know enough to ask questions to get more knowledge. Vicious circle, right? Reading the "Best of BIX," I get tantalizing glimpses into what by now must be a considerable knowledge base. Having it just out of my grasp is really frustrating. But the question is still there. In reality, the people who run (and price) the systems are controlling who has access to them. Set the price for correct information high enough, and no one will be able to use it. At that point, who is really in control of society and public opinion?

The French program to put a terminal next to every phone is progressing well. At last report, about 50 percent of private homes had the devices installed and operating. Now the French have to deal with the next step: how to police the abusers while providing the expected level of service to responsible subscribers. Remember when CB radio got so popular so fast? The service became saturated with fools and idiots, so much that legitimate users gave up. Soon, just about everyone quit using it. Now, so I am told, CB radio is tolerable once again.

The French are seeing an analogy to this in their public network. The seamy underside of society has reared its ugly head in the form of obscene conferences ranging from simple requests for heterosexual liaisons to bestiality, kiddie porn, and neo-Fascism. As it should be, the nature of the network software ensures the relative anonymity of the user. Since there is no restriction on who can enter a conference, young children and the not-quite-sane have equal levels of access. The whole ugly specter of censorship and who is capable of judging the competence of another human being is involved.

I have no doubt that the French will be able to sort out an enlightened solution. But as conferencing systems grow in the United States, you are sure to experience many of the same problems. The difference in the United States is that some of the less tolerant groups will attach their vision of society to a religious (or political, or whatever) banner and do their best to shut down the systems that offend their sensibilities. Their fear of the future will force them to act so, rather than face the ultimately liberating and civilizing (we hope) influence that increased knowledge brings.

Working for a German firm, I am getting a good taste of the computer angst, or fear, that exists here. Not to beat this unpleasant issue to death, but the German people do know what national socialism could have done had today's computer technology existed in 1936. As a result, every database (public, private, or governmental) that is in machine-readable or -sortable form is subject to constant scrutiny. The holders of the database must continually justify the existence of the records.

Charles Kuhlman
Mannheim, West Germany

Thanks for the update on conditions in Europe. We think BIX is a bit overpriced here! You have my sympathies.

It will be interesting to follow the French experience with networking. Thanks again.—Jerry

WordStar 4.0 Flaw

Dear Jerry,

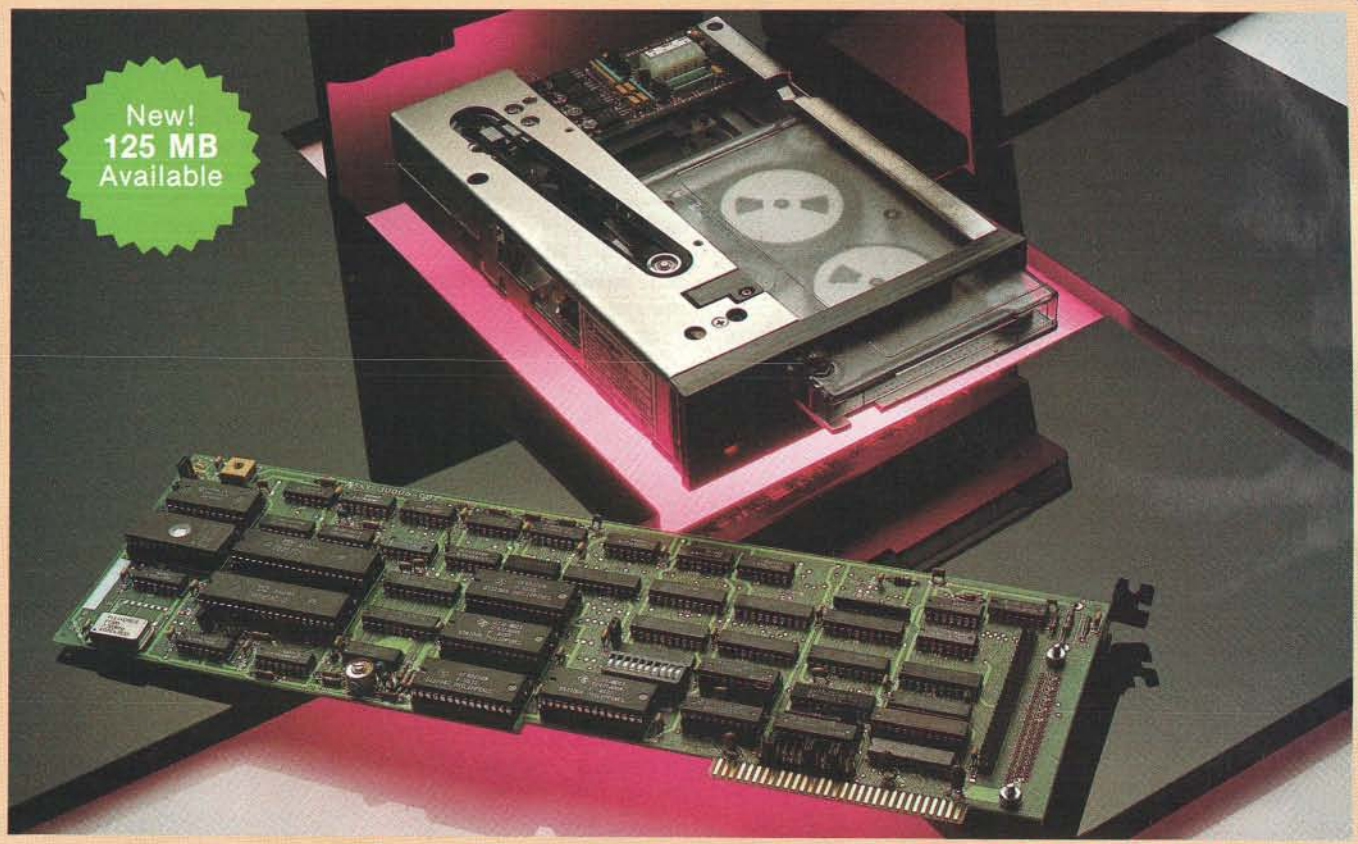
I recently received an update from WordStar 3.3 to WordStar 4.0 and found a very serious flaw in it.

When using WordStar 4.0 to generate source code for BASIC programs, the line-drawing functions Alt-F1 through Alt-F10 must not be used. Attempting to use such source code will totally lock up the computer, requiring the machine to be powered down to restore control. This is also true if the line graphics are generated using the Alt key plus a three-digit code. The computer will lock up when attempting to read the source code.

An examination of the code generated using the line-drawing graphics of WordStar 4.0 shows that the hexadecimal codes generated are different from those generated when using the line-drawing graphics codes of WordStar 2000 2.0. The graphics codes generated using

continued

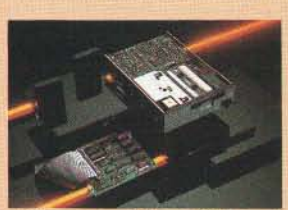
Automatic Backup Protection



. . . From Top-Notch Everex SCHEDULER™

- Automatic Scheduler™ for unattended backups
- File restore from image backup or file backup
- Backup across networks (using logical image or file-by-file)
- Physical image backup/restore of local disks
- Logical image backup/restore of local or remote disks
- File backup from any local or remote disk of any file size
- File-by-file and image backup on the same tape
- Multiple tapes to support unlimited backup capacity
- Multiple datasets for multiple backups on the same tape
- Tape sequence management recorded on the tape
- Menu-driven hardware configuration guide
- Backup any disk whether formatted for DOS or not
- Escape to DOS while in backup/restore operation
- File selection from directory listing or command line
- Context sensitive on-line help
- Dynamic display of tape status
- Multiple windows (nestable and movable)
- Extensive diagnostics

INDUSTRY STANDARD QIC-24 DATA FORMAT



$775 Excel Stream 20 Internal

$1195 Excel Stream 60 Internal

$1335 Excel Stream 60 External

$885 Excel Stream 20 External

$1295 Excel Stream 60 External

$925 Excel Stream 60-8 External

Utilize the features. Compare the performance. Count on our commitment to Excellence. Enjoy the Everex Protection TODAY!

For the name of your nearest EVEREX dealer or more information, call us. Remember...
We're EVER for EXcellence.™

1-800-821-0806
in U.S.

1-800-821-0807
in California

48431 Milmont Drive, Fremont, CA 94538
415-683-2100

EVEREX
EVER for EXcellence

Circle 93 on Reader Service Card (Dealers: 94)

...tar 2000 work correctly with ...ASIC language.

Thomas S. Cox
Greenville, SC

Thanks for the info. I confess I don't use WordStar as a programming editor; I prefer Brief or First Time.—Jerry

Praise for Pascal

Dear Jerry,

Your short remark about FTL Modula-2 in your February column made me think of my own experience with various programming languages. As a student in computer science (we call it "Informatik"), my first computer language was Wirth's Pascal. Maybe I'm a little short-sighted, but I think Pascal and its follower, Modula-2, are the best general-purpose programming languages. Thanks to Turbo Pascal, they're even suitable for quick-and-dirty little programs for one-time use. I have never learned BASIC, and I don't intend to. Seeing those silly line numbers and that ancient subroutine call scheme, I cannot understand why BASIC could survive.

Okay, current implementations give you very powerful functions, but it's all spaghetti because the concept of BASIC is spaghetti. Unfortunately, a great deal of serious (commercial) PC programming continues to be done in BASIC.

Manfred Jeusfeld
Aachen, West Germany

Well, BASICs are getting so many features that it's hard to tell some of them from Pascal except that BASIC has easier string-handling functions.

I agree, though, that if you have Turbo Pascal or FTL Modula-2, you don't need to learn BASIC in the first place.—Jerry

Stow the Nets

Dear Jerry,

I was appalled at your column in the April BYTE. Has what I've known and loved as personal computing gone the way of all silicon? Far be it from me to define what is or isn't personal computing, but I hardly think the vast majority of lowly mortal users can relate to the vast Olympian network you describe. I mean, you do get every piece of hard-/firm-/software under the *sun* for the asking, and it's great that you can link them all together, but other than yourself and a few very large corporations, who could possibly afford this?

Perhaps I've missed the bus. Most home users I know make do with one machine. If most companies are smart, it would seem to me that they ought to stick with one computer maker and go with its local area networks, terminals, or whatever—this would at least be simpler.

On the whole, I really like your column (and your science fiction), but I really think this sort of thing should be filed away under Possibly Productive Ergonomic Esoterica. Let's get back to helping The Rest of Us.

John J. Ross
New York, NY

The PC Arcnet isn't that expensive, and by using a PC or clone as the controller for a powerful system like the CompuPro, you can get quite a lot done. Agreed, it isn't for everyone, but surely we're still in the price range of microcomputers?

I agree, I have a great deal of equipment around here, and some of it is pretty advanced, but it has been my experience that today's expensive start-of-the-art equipment is tomorrow's required system; after that it becomes obsolete. A lot of people have been touting 1987 as the year of the LAN; surely I can be forgiven for experimenting with networks? After

continued

START HERE

WITH HOUSTON INSTRUMENT

Whether you're a newcomer to CAD or just looking for a reliable, low-cost plotter for your PC CAD system—start here. With the popular Houston Instrument™ DMP-41/42 series plotters.

Priced at $3,295*, these single-pen plotters give you the features you need for a sensible start—field-tested reliability, C and D size plots, good resolution, a wide selection of plotting media and pens, and compatibility with hundreds of software packages.

Enter the PC CAD world with the DMP-41/42 series—the plotters that offer superb reliability and excellent performance at a very affordable price. Learn about the advantages of HI's Priority Response Programs featuring a competitive leasing plan and an express service agreement that can replace your plotter overnight.

Begin by calling 1-800-531-5205 (512-835-0900 if in Texas) or writing Houston Instrument, 8500 Cameron Road, Austin, Texas 78753. In Europe, contact Houston Instrument, Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel.: 32-(0)59-277445. Tlx.: 846-81399.

houston instrument DIVISION / AMETEK

**U.S. suggested retail price. Prices subject to change. Houston Instrument is a trademark of AMETEK, Inc.*

Circle 126 on Reader Service Card

all, the motto is, "One user, at least one CPU. . . "—Jerry

Macintosh II Looks Good

Dear Jerry,

I just read a product preview of the new Macintosh II. My previous gripe with the Macintosh was its lack of color capability, expandability, MS-DOS compatibility, and its small screen size.

The color capability issue is, admittedly, a personal preference of mine. Expandability is necessary since personal computers still require modifications to the base unit to suit individual preferences. MS-DOS compatibility is necessary since we are reluctant to trash all our software for a new machine. As for the small screen size, I have the same gripe as you. A small screen is a crime on the eyes.

The new Mac II solves most of these problems, and in addition it adapts a useful bus architecture, the NuBus, and relegates most of the graphics and sound-thrashing to hardware, where it should be. The system looks to be the dream machine I have always wanted: a VAX-like microprocessor (68020), excellent color graphics, expandable architecture, and a good software base. Now, if the price were below $2000, I'd suck one up in a minute.

David Nakamoto
Pasadena, CA

We're in agreement on just about every point, especially on software investments forcing us to get DOS compatibility.

They tell me I'll get a Mac II Real Soon Now. I sure hope so; I've been impressed with all I've seen.—Jerry

Undocumented Feature

Dear Jerry,

After many phone contacts with AT&T regarding a problem I found with its version of MS-DOS, I received a letter explaining the source of difficulty and the proposed corrective action to be taken (if any/if needed/if ever). It reads:

> Thank you for reporting the inconsistency between the AT&T and IBM versions of MS-DOS, in dealing with interrupts while in a batch script. The inconsistency is due to an undocumented feature of the IBM version, and could therefore be changed by IBM at any time. Therefore, before any changes are made, if any changes are made, the problem will have to undergo further review. If a change is made, it will be included in a future release of MS-DOS.

Jim Sorrells
Somerdale, NJ

Yeah. Wow. Thanks for showing it to me.—Jerry

Not-So-New Keyboards

Dear Jerry,

Regarding your comments in the April BYTE on the "new" keyboards for IBM PCs and clones, let's give credit where credit is due. DEC Rainbow owners have been noting with irony that these keyboards look suspiciously like the LK201 keyboards that came with their computers.

Now that DEC is backing out of the microcomputer business, maybe we'll start to see other "advanced" features, such as true scrolling, crop up on other machines.

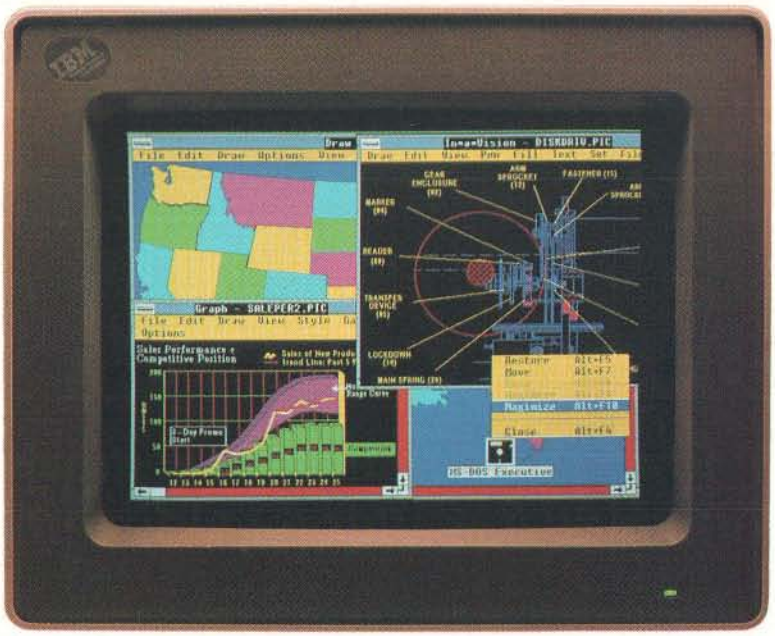
Carl D. Neiburger
San Jose, CA

DEC tried as hard as it could to alienate the micro community, and lo! it succeeded nicely.—Jerry ■

We Do Windows

Choose from a Complete Family of Windows compatible Graphics Applications.

Micrografx is the premier developer of graphics applications compatible with Microsoft Windows. And Windows DRAW, Windows GRAPH, and In*a*Vision are recognized as the leading graphics applications in the industry.



Windows DRAW is a business drawing and presentation graphics program, which includes over 1000 predefined clip art images. Windows DRAW was rated as the number one free-form graphics program by Software Digest (Dec., 1986) and is sold internationally by Microsoft.

Windows GRAPH is a business graphics and charting program, and is the newest member of the Micrografx family. With Windows GRAPH, you can create an unlimited variety of area, bar, column, line, pie, scatter, combination, and table graphs. Use existing spreadsheet data or enter data directly to create a stunning array of two- and three-dimensional color graphics. Then enhance your charts with free-form drawings, multi-font text and clip art.

In*a*Vision is a powerful, easy-to-use Computer Aided Design (CAD) program. In*a*Vision was the first Windows-compatible program and according to PC Magazine (June, 1987), "In*a*Vision is still the best Windows-specific application." In*a*Vision is ideal for design professionals. Whether you are creating complex technical drawings, schematics, flowcharts, floor plans, organization charts or designing your own new kitchen, In*a*Vision makes your job easier.

Each Micrografx application is compatible with Microsoft Windows. And compatibility with Windows today guarantees an easy upgrade path to the Windows of tomorrow.

With Windows, each Micrografx application can run in a window simultaneously with any other Windows application. And Micrografx' applications are data compatible with all other Windows applications through the Windows Clipboard. A common user-interface, pull-down menus, mouse support, shared device drivers and our common "object-oriented" file structure gives you consistent ease-of-use and top-quality output. Our PostScript and PageMaker compatibility means that all of the graphics you create are perfect for desktop and professional publishing.

In addition, Micrografx offers Windows ClipArt with over 1000 business-oriented images and CAD ClipArt with over 1000 images from the architectural, electrical, chemical, and mechanical engineering fields. And through Windows CONVERT, your graphics are fully compatible with the AutoCAD data exchange format (DXF).

For additional information about how to put Micrografx to work for you, call your local authorized dealer, or contact Micrografx toll-free, at **800-272-DRAW** (in Texas 214-234-1769) or write to Micrografx Inc., 1820 N. Greenville Ave., Richardson Texas 75081. Call today and let Micrografx take the dirty work out of doing Windows.

MICROGRAFX

The Picture of Success

Supports the IBM AT standard

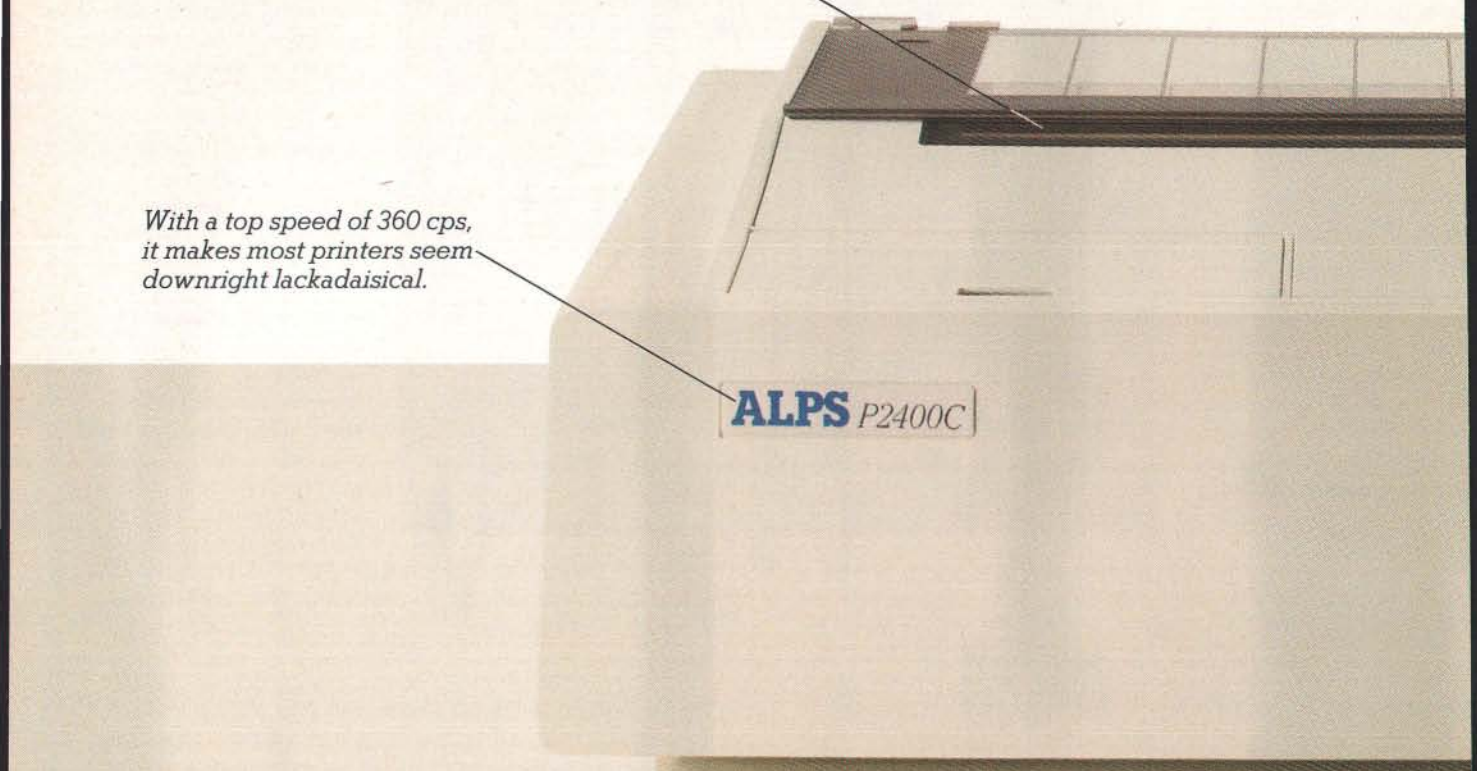
Supports the new IBM PS/2 standard

Circle 172 on Reader Service Card

ALL IT LACKS IS

A choice of snap-in/out, 24- or 18-pin print heads gives you the versatility and ease of maintenance that other printers lack.

With a top speed of 360 cps, it makes most printers seem downright lackadaisical.

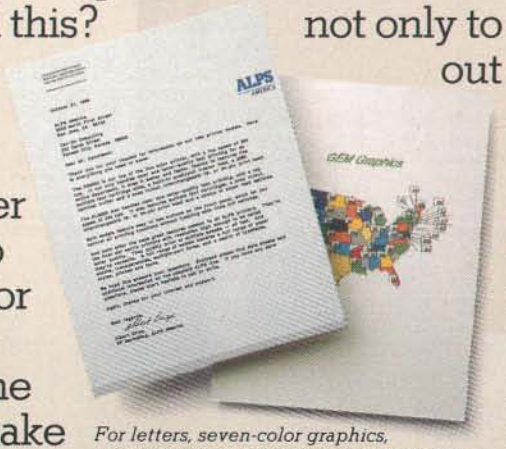


But who needs competition when you've got all this?

Namely, the ALPS P2400C™ Dot Matrix Printer.

No other printer in its class can do so much for so many for so little.

For instance, the P2400C can easily take on all the work an office full of busy PCs can dish out.



For letters, seven-color graphics, spreadsheets or whatever, its output is so brilliant, everything else appears lackluster.

And take care of it faster. Thanks not only to its talents pointed out above, but to its many others, as well.

Like a choice of draft, correspondence and letter quality print modes. A print buffer expandable to 256K. Multiple font cartridges. And full compatibility with the most popular PCs and software.

COMPETITION.

Most printers lack the good sense to include a paper-saving, push/pull tractor for both bottom and rear feed. Not this one.

You also get conveniences that many other printers are lacking. Like control of everything from the front panel, the feature menu, or from software—without using DIP switches.

Not to mention the ability to run quietly. At under 55dBA, the P24000C is one of the least noisy printers around.

One of the most durable, too. It comes with a full, one-year limited warranty. And if you give it normal care, it'll give you over five years of trouble-free performance.

Of course, there's nothing like a live performance to prove there's nothing like the P2400C.

For a free demo, or more information, call us at **(800) 828-ALPS.** In California, (800) 257-7872.

And see what every other dot matrix printer is lacking.

ALPS
AMERICA

IT'S TIME YOU SAW THE ALPS.

Circle 11 on Reader Service Card (Dealers: 12)

Introducing An Exciting Breakthrough in Access Performance

*Access Your Data 3.6 Times Faster**

CO-STAR™

CO-STAR is a unique data storage subsystem containing either an 80-megabyte or a 150-megabyte disk drive and a hard drive controller card with a powerful difference: an on-board disk-management co-processor.

Fast Disk

Now you can get incredibly fast disk access performance from your IBM PC/XT, AT or compatible with Nestar's breakthrough co-processor technology.

Co-Processing

Co-processing means that while your system CPU runs applications without interruption or memory overhead, CO-STAR runs invisibly in the background with an array of sophisticated disk-management functions, such as

- 1. File and disk space optimized for most efficient retrieval
- 2. Intelligent buffering, dramatically reducing disk access delays

PLUS

- DOS 32 megabyte file size — limitation is eliminated
- Performs print spooling
- Fast access SCSI interface connecting up to 8 devices

Disk-Intensive Applications

CO-STAR can increase productivity up to 366 percent! — in applications like data base management, accounting, CAD/CAM and desktop publishing.

Complete System

CO-STAR subsystems include everything:

- Top-rated hard disk drives
- CO-STAR disk controller, 256K of memory (expandable to 1 Mb) with a co-processor
- Cabling
- Easy installation software for DOS 3.X
- User manual
- Free 800-phone technical support

Don't miss out on our limited-time introductory prices.

80 Mb CO-STAR System Half Height Internal Drive	$1,495.00
150 Mb CO-STAR System Full Height Internal Drive	$2,495.00

Money Back Guarantee

If you're not completely satisfied with your CO-STAR system, return it to Nestar within 30 days for a full refund. A 12-month return to factory, limited warranty.

To learn more about CO-STAR and how new technologies have been used to deliver you great disk performance, call or write today for your free copy of George Morrow's "11 Design Innovations That Improve Disk Performance."

dsc Nestar Systems

A Member of the Business Network Systems Group of DSC Communications Corporation.

1345 Shorebird Way
Mountain View, California 94043-1339

To order, call us direct at

☎ 1-800-832-7274

8:00 AM - 5:00 PM Pacific Time

VISA, M/C, Am Ex

*Based upon reading 1000 sequential sectors, one at a time. Full comparative tests using standard industry benchmarks are available upon request.

MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry.

Optical Storage Growing Up, Facing the Magnetic Challenge

No one ever said making an optical disk was easy, certainly not manufacturing experts at a recent conference on optical drives and media. As Richard Zeck, of Rothchild Consultants (San Francisco), explained, you have to worry about things like the multiple layers of a disk matching both optically and thermally and tracks only 1 micron wide, 10 to 15 times narrower than with magnetic media.

Richard Gardner of 3M Company (Vadnais Heights, MN), a major North American producer of optical disks, described 3M's manufacturing process as having more than 1000 separate steps per disk, 475 of those steps in the thin-film deposition process alone. The most critical factor, at least from 3M's perspective, is the implementation of on-line diagnostic devices that measure key observable parameters, such as bonding and lamination and handling. "Testing must occur inside the system as the product is being made," he said. "The only thing you learn from downstream testing is that what you just made is garbage."

According to Gardner, the 3M optical disk manufacturing line is monitored by a single person, the control operator, who watches each step of the process for each disk. With each step, data is sent back to the operator, who then analyzes that data using a mainframe computer. Modifications can then be made during the manufacturing process. "We know while a disk is being made whether or not it is any good," Gardner explained.

Frans Carpay, director of manufacturing for Philips and DuPont Optical Company (Nieuwegein, The Netherlands), explained that it now takes 7 minutes to make a disk ("In one end of the line, you put in granulate; at the other end is a disk") and that overall production yield is 25 percent greater than with first-generation techniques. Carpay stated that the company currently produces blank disks that can be sold to customers for between $1.60 and $1.70 each.

Even though the optical storage industry is still in its infancy, said Zeck, it's mired in a period of transition. "There will be at least three, maybe five, generations of products," he said, "and we are only in the first generation." Zeck said that by the 1990s, "Optical storage will be a very large successful market."

Zeck described several trends he sees developing in optical memory, particularly the emergence of 5¼-inch, half-height drives. "There's no question about it," he said. "A majority of the optical drive manufacturers will be making 5¼- and before long 3½-inch units that are half-height because this is what the market wants."

Developments like holographic optical elements, higher power laser diodes (which use shorter wavelengths and diode arrays), better position sensors, and single-element molded aspheric lenses have enabled manufacturers to design smaller drives that have multiple heads, Zeck said. He explained that innovations like diode lasers with shorter wavelengths will make doubling of the bit and track densities possible, effectively quadrupling the storage capacity, while laser diode arrays will permit multichannel read/writes. Some of the laser diode arrays may also incorporate fiber-optic arrays.

Zeck predicted such innovations will gain widespread use in the next three years; we'll also see optical drives with 30-ms access times, he said.

Zeck doesn't discount magnetic storage altogether, however. He sees the "continuing evolution of magnetic technology, which annually improves in both capacity and throughput and decreases in price" as one of the most formidable challenges optical storage must overcome. In many environments, magnetic storage is still more cost-effective than optical storage, and systems like Konica's high-capacity 5¼-inch disk drive continue to make it tough on optical devices. In addition to high costs and sometimes low performance, Zeck said, the biggest problem for optical storage is both the lack of stan-

continued

Nanobytes

Amid all the glittering graphics technology at SIGGRAPH-87, we found a humble new device for controlling screen images. Called the **Spaceball**, this tangerine-size unit, mounted to a molded base, is filled with force/motion sensors; when you twist the ball, the sensors read the direction of the pressure and rotate the image on the screen accordingly. Push on the ball and the image recedes into the background; pull it and the image moves into the foreground. The pickups are filtered to eliminate the first 10 percent of motion. Inventor John Hilton said that because the Spaceball has its own processor, it can be software-configured to work with any system or application. Spatial Systems (Milsons Point, Australia) is testing the device now; at press time, it wasn't yet being marketed.... **The Software Link** (Atlanta) sounds pretty sure of its PC-MOS/386 operating system for 80386-based machines. The company says that if a commercial application or utility doesn't run under its OS, it will work with the developer to fix the cause of incompatibility. If they can't correct the problem, the owner can return PC-MOS/386 and get a full refund.... **Mercury Computer Systems** (Lowell, MA) showed at SIGGRAPH an add-in board for IBM PC ATs engaged in computation-intensive work. The MC3200 Micro-Supercomputer, built around the Weitek 8032 chip set, uses three 32-bit processors to handle program sequencing, integer processing, and floating-point operations. Mercury claims performance of 5 to 25 times that of an 80386/80287 combo. With 2 megabytes of RAM, the board costs $8000; the software de-

continued

velopment package is $8500. . . . **The Semiconductor Industry Association** (Cupertino, CA) has appointed five scientists to an advisory panel that will study the possibility of doing a study on possible health hazards of working in a chip fabrication plant. The head of the panel said it will first try to find researchers interested in doing an epidemiologic study of workers at semiconductor plants. . . . **MIT's Randall Davis** told a group of manufacturing planners that **factory automation** won't save much money on the assembly line but will have an impact at the inventory level, where there's more room for cutting costs (he said that only 5 percent to 10 percent of a factory's resources are devoted to assembly). Davis speculated that robots and expert systems may have their biggest impact on middle managers. "Maybe the real consequence of factory automation will be in thinning management ranks, since these are the people who have typically dealt with inventory and accounting, areas that will need less management in the future." . . . **TokiAmerica Technologies** (Irvine, CA) will soon start shipping its wire, which contracts, just like muscle tissue, when current is applied to it. Called BioMetal, it's a nickel-titanium member of the shape-memory family of alloys. According to a company executive, one disk drive maker is exploring BioMetal's use as a replacement for the solenoids and small electric motors that raise and lower the drive's read/write heads. The metal doesn't emit a large magnetic field. Another researcher reportedly has used the wire in a robot arm to probe integrated circuits. . . . **Data Technology** (Santa Clara, CA) says it will come out with a smaller, less expensive model of its CrystalPrint VIII, a page printer that uses a liquid-crystal shutter. The CrystalPrint IX will print six pages per minute and will be priced "at the bottom of the market."

dards and the lack of an industry leader. "The very diversity of optical storage options is perhaps its biggest negative," he said. "IBM's announcement of its 3363 [optical drive in April] was very important, but we're still waiting for the overall breakout type of leadership that's needed."

The Minicomputer: An Endangered Species?

"Taking aim" might be the best way to describe the combined Microsoft/Intel position regarding the future of 80386-based personal computers running the Xenix operating system. Both Steve Ballmer, vice president of system software at Microsoft (Redmond, WA), and Claude Leglise, 86-family marketing manager at Intel (Santa Clara, CA), described an 80386-based Xenix system as having power that not only rivals a DEC VAX, IBM 370, or Hewlett-Packard minicomputer but that outperforms those systems.

"The top three contenders in the minicomputer market," said Leglise, are the IBM 370, DEC VAXes, and an 80386-based IBM PC. "All offer 32-bit capabilities, a large address space, and virtual storage architecture. However, a '386 today delivers more CPU power than the IBM or VAX." Ballmer agreed, stating "386 Xenix is a multiuser system that competes with low-end VAX, an IBM System 36, and a Hewlett-Packard minicomputer more so than it competes with DOS." According to Ballmer, the installed base of Unix/Xenix users exceeds 250,000, making it the largest installed base for multiuser operating systems in the world. "Some people don't think 250,000 is a very big number," Ballmer said, "and it isn't if you compare it to 10 million DOS users. However, it is a very big number if you compare it to the fewer-than-100,000 VAX VMS installed base."

Both men lauded the standardized, binary Unix platform the 80386 makes possible. "No other processor or architecture can make this claim," boasted Leglise, while Ballmer added that "it's a way of putting a level of standardization into the minicomputer market."

According to Ballmer, Microsoft's operating system strategy is threefold: DOS and Windows for real mode, OS/2 for protected mode, and Xenix for multiuser environments. "DOS and OS/2 remain single-user systems," said Ballmer. "We will use OS/2 to penetrate mission-critical markets like airline reservation systems."

Paul Sribhibhadh, Microsoft's Xenix marketing manager, told Microbytes Daily that Xenix sales "are doing better than ever since the OS/2 announcement." Ballmer said Microsoft has "never had a higher level of Xenix development" than it does now. According to Sribhibhadh, the Xenix development team at Microsoft consists of about 30 people.

Leglise, who noted that the 80486 won't be available for quite a while, predicted that by the end of the century, Intel "will deliver a chip that will compete effectively against a mainframe."

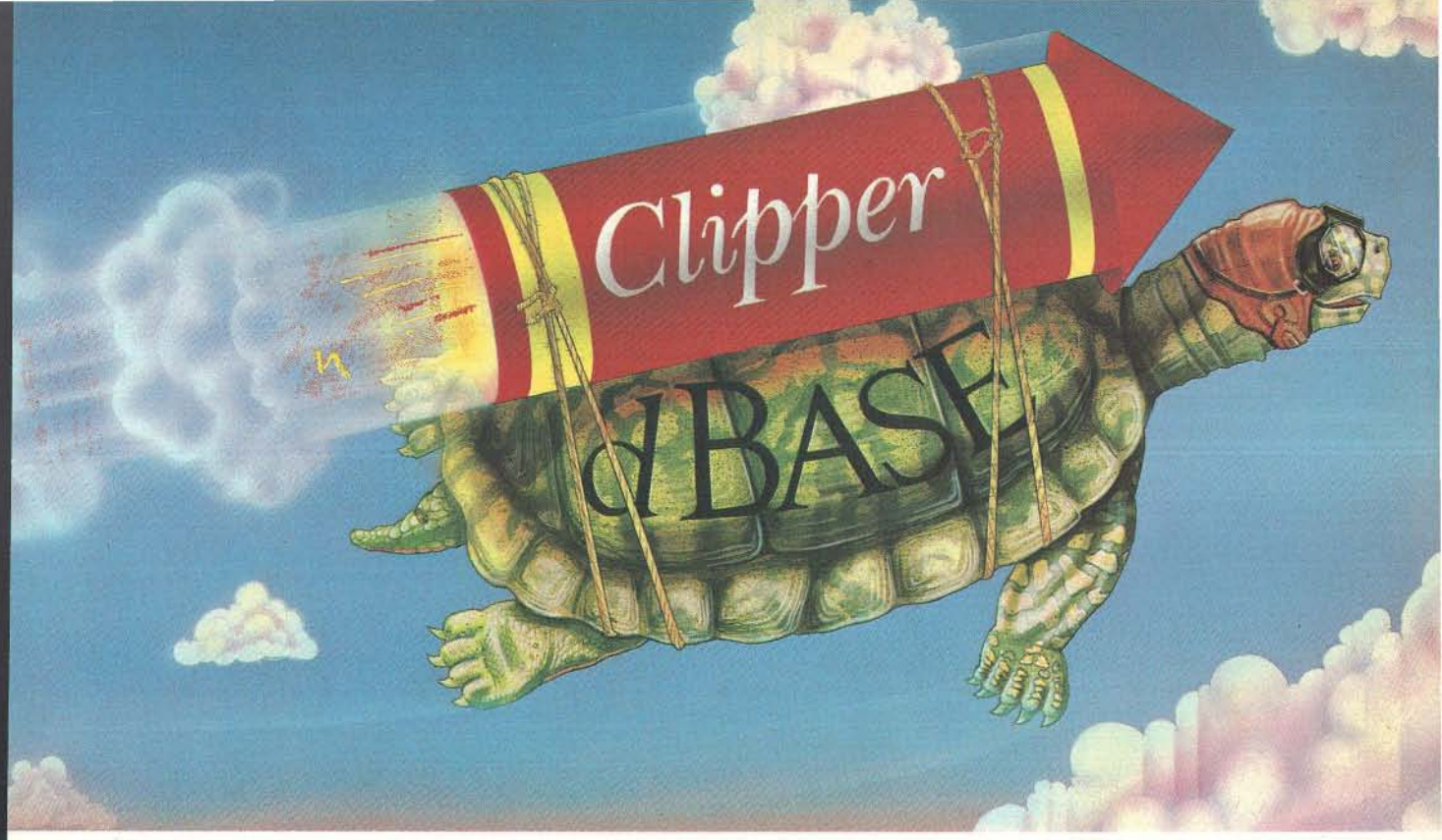
Coprocessor Will Enhance Amiga Graphics

A prototype parallel imaging coprocessor board has been developed for the Commodore Amiga 2000 by the University of Lowell (MA) Center for Productivity Enhancement. Called the Amiga Parallel Imaging Coprocessor, the card is built around the NEC μPD7281 Image Pipelined Processor (ImPP), which executes at the rate of 5 million instructions per second. However, because the board can accommodate as many as seven ImPPs, an effective processing rate of up to 35 MIPS can be achieved. The board can also perform DMA transfers of images within 512K bytes of graphics memory and within up to 8 megabytes of system memory.

According to Georges Grinstein, associate professor of computer science at the University of Lowell, the board is programmable and will come with a development environment that includes an ImPP assembler, a run-time support library, and an image-processing library (filters, geometrical operations, processing routines, and so on). The board can be programmed through the C run-time library or through an imaging kernel system (also developed by the University of Lowell).

Grinstein said at SIGGRAPH-87 (in July) that the board would soon go into production and would be available in September for approximately $2000.

continued



Turtle Souped

Real programmers don't use dBASE. Or do they?

We're finding that some very swift programmers are using it to write some very fast applications, and are completing their projects much more quickly.

But they cheat.

They use our Clipper™ compiler to combine dBASE™ with C and assembler.

With dBASE used like pseudo-code, they can then quickly create prototypes that actually run.

Then, with dBASE doing the high-level database functions, they use our Clipper compiler to link in C or assembly language modules from their own bag of tricks.

And they're finding that they're linking in less than they expected because Clipper compiled code runs so fast and because of Clipper's built-in enhancements.

Clipper includes easy networking that provides file and record locking the way it should be done.

Fast screens that can be treated as memory variables and eliminate the need for direct screen writes and all that tortuous heap management code.

Box commands that make windowing a breeze. And more.

So if you'd like to use your time more productively, check us out: Nantucket Corporation, 12555 W. Jefferson Boulevard, Los Angeles, CA 90066.

Or if you're on deadline, call (213) 390-7923 today.

Clipper could get you out of the soup.

Nantucket®

Some Researchers Concerned with Defense Funding of AI Projects

One of the most heated topics of talk at the recent AAAI-87 in Seattle concerned the role of the Department of Defense's Strategic Computing Initiative (SCI) in AI research. AI researchers, particularly those in universities who see themselves as "antimilitary," are facing a real dilemma: They don't want their work used for military applications, but no one else seems ready to pay the bills. The only realistic perspective, according to Rod Brooks, an MIT researcher heavily involved in the SCI-sponsored Autonomous Land Vehicle (ALV) program, is to realize that research results can be used for all sorts of purposes and that a researcher cannot assume responsibility for every eventual application.

Randall Davis, another university researcher working on SCI-related projects, agreed, pointing out that many of the algorithms being used with missile systems were originally developed by medical researchers. Jon Jacky of the University of Washington concurred: "You can never have complete control over the results of your work."

SCI, with its 1987 budget of slightly more than $116 million, is a DARPA (Defense Advanced Research Projects Agency) program started by Robert Kahn in 1983. SCI has four major goals: to advance machine intelligence technology, to aid in the transition of this technology from laboratories to industry, to increase the availability of trained scientists and engineers, and to provide a broad base of supporting research for advanced machine-intelligence technology. General areas of technology research include computer vision, speech processing, natural-language processing, knowledge-based systems, integrated interfaces, architectures, and microelectronics.

More than one-third of SCI's 1986 $116.3 million budget was released to university research laboratories; 26 percent was allocated for multiprocessor system architectures, 20 percent for applications (e.g., ALV), and 16 percent for machine intelligence. Although the 1987 budget will be cut to just over $104 million, the 1988 projected budget will be up to about $120 million. Robert Simpson, the DARPA administrator responsible for overseeing SCI, added that SCI is the funding source for AI and computers within DARPA.

Questioned about the relationship between SCI and the Strategic Defense Initiative (SDI), commonly referred to as the "star wars defense," Simpson pointed out that the two are not related; however, "technologies developed by SCI are available to the entire Defense Department." Simpson mentioned that SDI researchers are very interested in the parallel computing architectures at Carnegie-Mellon University (see the story on the Warp Computer in April's Microbytes, page 10).

When asked why SCI funds could not be turned over to a nonmilitary agency, such as the National Science Foundation, for distribution to universities, Simpson said "it's unlikely" that the DoD would agree to deliver millions of dollars to the NSF simply to create the impression of "clean money."

No LAN Is an Island, E-Mail Panel Says

The lack of intersystem connections has been the single biggest obstacle for electronic-mail users and vendors, according to a panel of e-mail experts speaking in San Francisco recently.

But one panelist, Richard Miller of Telematica (Palo Alto, CA), said the technical problems of "interconnecting islands of communication" have been solved so that users of one e-mail system can send and receive mail to and from users on other systems. The problems that now exist, said Miller, are primarily administrative.

"Within companies, the problem is to convince the various parts of the organization that they really can talk to one another," said Miller. "Usually that isn't dealt with until a CEO finds out he can't send a message to the entire company." Peter Westwood, vice president of Sydney Development Corp. (Vancouver, British Columbia), added that more than 80 percent of the e-mail systems that serve the more than 6 million active e-mail users in the United States are capable of communicating with one another, but whether or not they actually do is another matter.

Miller and the other speakers on the panel credited the adoption by e-mail vendors of the X.400 protocol standards with helping greatly to make interconnection possible. Those standards are backed by the Electronic Mail Association and are now being considered for adoption by the National Bureau of Standards in the United States and by Cen/Cenelec in Europe.

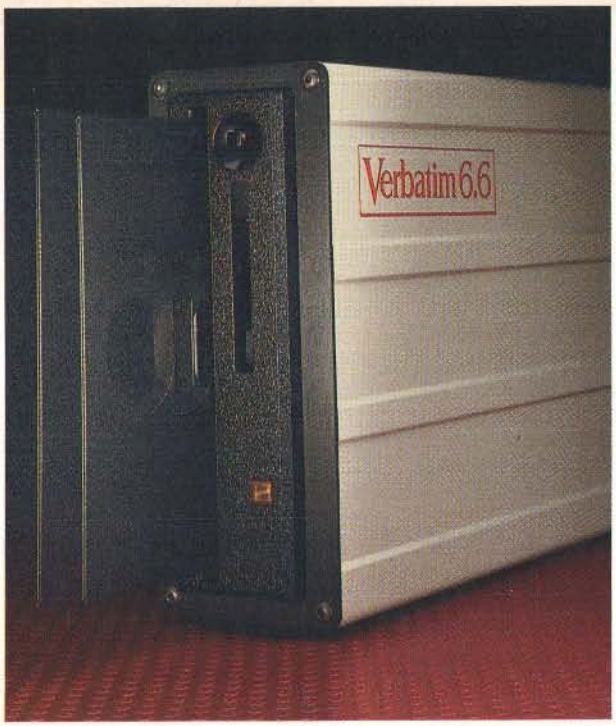
"We are at the point today," Miller said, "where X.400 is no longer a dream. Real services and real products are out there." X.400 is a global messaging interconnection protocol that defines the envelopes and text format of message naming, addressing, and routing schemes.

When asked about the implications that X.400 might pose for broad-based Unix systems like Arpanet, UUCP, and others, however, Westwood admitted it is unlikely that those systems will adopt the X.400 protocol. Instead, vendors, like Westwood's company, will be offering gateways to those systems.

Russell Briggs, an e-mail consultant and president of DA Systems (Campbell, CA), agreed. "The Unix systems work now," said Briggs, "and there probably will be little incentive to adopt X.400. The alternative is to provide gateways." Briggs added that implementing X.400 protocol is not cheap and predicted that many e-mail systems will turn to gateways or to services like DA System's recently introduced DASnet.

DASnet is a service that allows the exchange of electronic mail between users of most of the major e-mail systems. With a DASnet, an e-mail user can reach almost everyone who has an account on a public or for-fee system using the mail system with which they have become familiar, regardless of the destination.

TECHNOLOGY NEWS WANTED. *The news staff at BYTE is always interested in hearing about new technological and scientific developments that might have an impact on microcomputers and the people who use them. We also want to keep track of innovative uses of that technology. If you know of advances or projects that involve research relevant to microcomputing and want to share that information, please contact us. Call the Microbytes staff at (603) 924-9281, send mail on BIX to Microbytes, or write to us at One Phoenix Mill Lane, Peterborough, NH 03458.*



Verbatim 6.6 MB subsystems: high capacity with the convenience and security of removable floppies.

You'll appreciate the advantages of Verbatim 6.6 MB subsystems from Kodak.

You get 5.57 MB of formatted capacity and all the benefits of removable floppies. Store unlimited amounts of data. Easily transport files. Secure important information. And back up your hard disk quickly and reliably.

No need to throw away existing disks. This subsystem can read disks with 48, 96, and 192 tpi. Available to fit inside or alongside your IBM PS/2 model 30 *or* IBM PC/XT/AT *and compatibles. Everything you need for fast, easy installation comes with the package. And you're protected by a one-year warranty.*

Ask your computer dealer about this new Verbatim subsystem and media. Or call 1-800-44KODAK, ext. 990.

Free Back-It *software for hard-disk backup with purchase, while supplies last.*

6.6 MB OF ADDED STORAGE FROM KODAK

The new vision of Kodak

Kodak

Circle 88 on Reader Service Card

Ideal Working Conditions

If you're looking for a high-speed laser printer that can easily handle as many as 25,000 pages a month, the new Toshiba PageLaser12® is the machine for you.

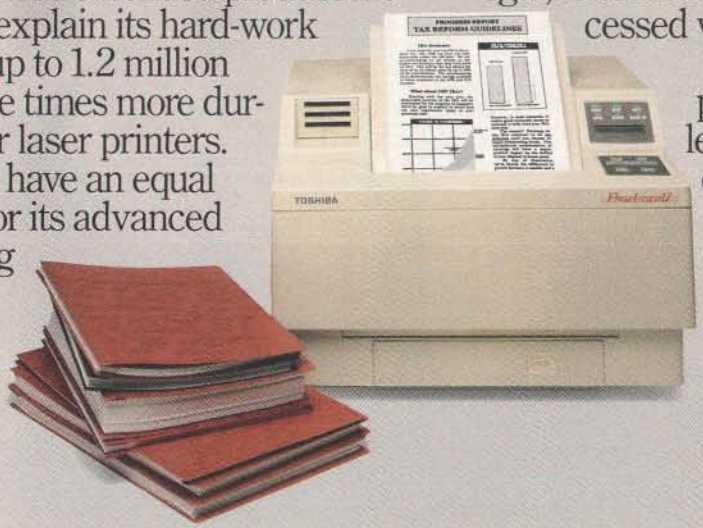
It thrives in any high-volume office environment. Whether it consists of a productive single user, or a network of multiple users sharing the workload.

PageLaser12's extended product life might help to explain its hard-work mentality. At up to 1.2 million pages, it's three times more durable than other laser printers.

You'll also have an equal appreciation for its advanced paper handling options. Our Toshiba-made dual-bin paper feeders, combined with PageLaser12's standard cassette feeder, give you a paper capacity of 750 sheets.

That's 500 sheets more than most other laser printers.

But here's the best part. With three paper feeders, you can now print multiple paper types and sizes automatically. Letter, legal, letterhead, even labels can be accessed with no physical change.



What's more, our optional proprietary envelope feeder lets you print large quantities of envelopes without constantly banging away on your office typewriter.

You can also use the same font style that appears on your letters to create a

For The PageLaser12.

more professional, unified look.

But don't think for a second all these bells and whistles slow down performance. At 12 pages per minute, PageLaser12 is up to 50% faster than many other laser printers.

As for multiple emulations, HP LaserJet 500 Plus,® Diablo,® IBM® Graphics, Qume® and Toshiba P351 all come standard, as do parallel/serial interfaces. There's also a 1.5MB memory option for full-page 300 dpi graphics. And our optional output jogger/collator ensures easy separation of multiple copy output. All of which means PageLaser12 can meet the needs of any office worker.

A complete library of Toshiba font cartridges is available with multiple HP LaserJet-compatible fonts on each cartridge. And

PageLaser12's high-volume capability and low-priced supplies produce one of the lowest desktop laser costs per page in existence.

To top it off, you get all this high-volume ingenuity, speed and flexibility for what you'd expect to pay for a less equipped low-volume laser printer.

So if your business prospers on high volume, get the laser printer that does the same. The PageLaser12.

For more details, call 1-800-457-7777 for the name of the Toshiba printer and computer dealer nearest you.

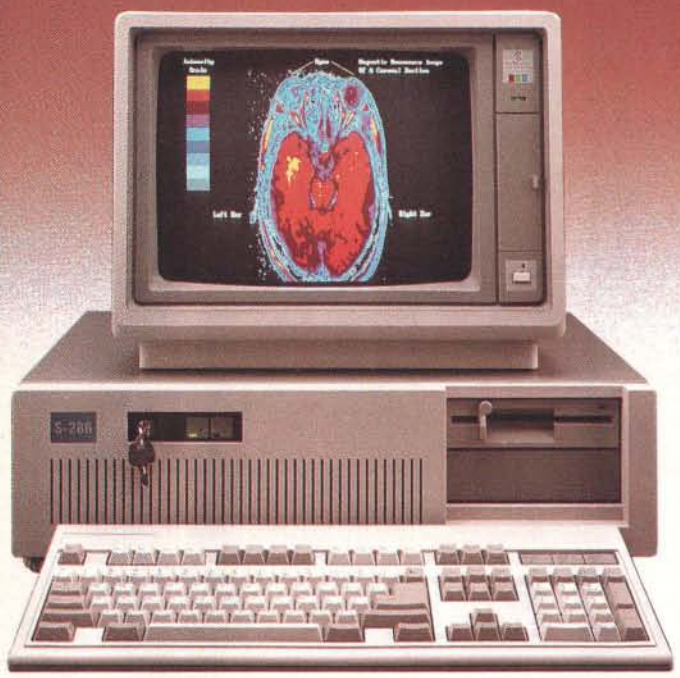
Then see how well PageLaser12 performs in your surroundings.

In Touch with Tomorrow

TOSHIBA

Toshiba America, Inc., Information Systems Division

SAMSUNG
provides compatibility and beyond



SAMSUNG S-286 (Base System) includes:

- Intel 80286-8 CPU with 8 Expansion Slots.
- 1Mb Standard RAM Memory On Board (100nS Chips).
- Combined 2 Floppy/2 Hard Disk Controller Card (Western Digital WA2).
- 200 Watt Power Supply 230/115 V Switchable.
- Clock Calendar with Battery Back-up (Rechargeable Battery).
- 6 or 8MHz Clock Speed (Switch Selectable).
- Wait or No Wait Memory Access (Switch Selectable).
- 1.2Mb Floppy Disk Drive.
- 2 Serial Ports and 1 Parallel Port (Built-in Motherboard).
- Enhanced 101 MAXISWITCH™ Keyboard.
- Push Button for Hardware Reset. • Hardware Reference Manual.
- Awards ROM BIOS (100% Compatible and Faster).
- Landmark CPU Test Shows 10.3MHz at 8MHz on 0 Wait State.
- One Year Complete Warranty Parts & Labor. • FCC/UL Approved.

S-286 EGA System — $1690

- Includes Base System (Shown Above).
- Samsung 14" EGA Monitor (640 x 350).
- Video-7™ VEGA Deluxe Extra Hi-resolution EGA Card.

NEW LOW PRICES

With 20Mb Seagate ST-225 ½HT 65mS **$1960**

With 30Mb Seagate ST-4038 Full HT 39mS **$2180**

S-286 Monochrome System — $1250

- Includes Base System (Shown Above).
- MGA Card.
- Samsung 12" Hi-resolution Monochrome Amber Monitor with Tilt and Swivel Base.

NEW LOW PRICES

With 20Mb Seagate ST-225 ½HT 65mS **$1540**

With 30Mb Seagate ST-4038 Full HT 39mS **$1740**

OPTIONAL PRODUCTS

- Samsung 12" Amber and Green Monochrome Monitor with Tilt and Swivel Base ..... **$ 75**
- Video-7™ VEGA Deluxe EGA Card **329**
- Seagate ST-225 ½HT 20Mb Hard Disk Drive 65mS Access Time **270**
- Seagate ST-4038 Full HT 30Mb Hard Disk Drive 39mS Access Time **490**
- Samsung 14" EGA Monitor **$350**
- Modem - 1200 Baud **95**
- Modem - 2400 Baud **245**
- Tape Back-up Samsung SACT40Q 40Mb Internal **410**
- Toshiba 360K Floppy Disk Drive **95**
- Chinon 360K Floppy Disk Drive **90**

TO ORDER IN CA CALL TOLL FREE
800-543-8868

TECH SUPPORT & INFO
(408) 737-8585

TO ORDER CALL TOLL FREE **1-800-451-8556**

Hours: *Mon - Fri 8:00 am - 6:00 pm (PST)*
Saturday 8:00 am - 3:00 pm (PST)

PC HOME
473 Macara Avenue
Suite 706
Sunnyvale, CA 94086

VISA · MasterCard · American Express Card

TERMS: Orders shipped same day on all stocked products. We accept Visa, MasterCard, 3% extra on Amex, wire transfers, qualified PO's and C.O.D.'s. Only factory sealed and fully warrantied products stocked. PC Home extends a one year complete warranty to be free from defects in materials and workmanship on all products. Returned items must be shipped prepaid and insured, and must contain an MRA number on the shipping label. CA residents add 6½% sales tax. Prices are subject to change without notice.

Circle 206 on Reader Service Card

Fortune's Supermicro Supports 2 to 20 Users

Sporting a 68020 processor running at 16.5 megahertz, the Fortune Formula 4000 is a desktop computer system that supports from 2 to 20. The system runs Fortune's proprietary Unix-based operating system, FOR:PRO. The company says system V.3 will be released later this year. Also available is Fortune:Works, a package that lets IBM PCs and compatibles access FOR:PRO files.

The 4000 includes four standard expansion slots, one of which is reserved for the SCSI host adapter. Two slots are also available for memory expansion. The main system has two full-height drive slots. An expansion cabinet with two additional full-height drives is also available.

Fortune's entry-level configuration includes 1 megabyte of RAM and a 40-megabyte hard disk drive. A fully loaded high-end system includes a 145-megabyte hard disk drive, 4 megabytes of RAM, a 60-megabyte tape-backup unit, and a complete set of Fortune Office Automation software.
Price: $9900 to $19,900.
Contact: Fortune Systems/SCI Technology Inc., 300 Harbor Blvd., Belmont, CA 94002, (415) 593-9000.
Inquiry 575.

A New Interleaf

Interleaf's electronic publishing program has been ported down to the Macintosh from the mainframe world. It retains the full features that enable you to compose, edit, and print documents with multifont text and graphics, including CAD and freehand drawings, charts, diagrams, photographs, and line art. The program takes over the Macintosh screen with its own desktop and offers a component bar for changing fonts and other characteristics. Changes are made globally across the document, including repagination, auto-hyphenation, and auto-numbering.

The 68020-based Formula 4000 can support 20 users.

You can use a mouse to access pop-up menus and a keyboard for word processing.

A spelling checker, based on *The American Heritage Dictionary*, spell-checks and offers choices of corrections.

An object-oriented graphics editor enables you to add text to graphics, align, center, copy, ungroup, move, rotate, size, and cut. You can zoom in graphics mode but not in text mode, and you can edit zoomed objects. Instead of using a ruler in graphics mode, you can create an object on a grid and align objects or parts of objects to grid points.

A data-driven charting feature accepts data from Lotus 1-2-3 and other programs in ASCII format. You can also import data from the Macintosh Clipboard.

Page-layout functions include rotate, size, cut, and copy, and you can enter text into the page or cut and paste it in. Word-processing functions are also available.

A referencing function dynamically links all references throughout a document.

Interleaf reports that document length is limited primarily by disk size.

The program requires a Mac II. A color screen is recommended for use with WYSIWYG (what you see is what you get) features but is not necessary to run the program.
Price: $2495.
Contact: Interleaf Inc., 10 Canal Park, Cambridge, MA 02141, (617) 577-9800.
Inquiry 576.

SEND US YOUR NEW PRODUCT RELEASE

If you want us to consider your product for publication, send us full information about it, including its price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE does not represent itself has having formally reviewed each product mentioned.

Three Neural-Network Programs

MacBrain, a Macintosh neural-network-simulation program from Neuronics, supports up to 200 processing nodes and provides up to 40,000 connections. It contains an interpreter and paradigm shells. You can simulate adaptive resonance, the Delta rule, Boltzman machines, and Hopfield nets.

The program supports color on the Mac II and provides seven instruments to display units and four ways to display weights and links.

MacBrain runs on the Mac Plus, SE, or II. The company plans to support Transputer-based boards in a future release that will also include two programming languages.
Price: $99.
Contact: Neuronics Inc., P.O. Box 738, Cambridge, MA 02142, (617) 367-9254.
Inquiry 577.

NeuralWorks is an IBM PC development tool for designing and building neural applications and models. It uses a graphic intuitive interface and offers editing, execution, tuning, and observation capabilities. The editing functions let you lay out the network in layers, then interconnect the layers with one of four methods. You can specify the layers manually, replicate an existing pattern, connect them randomly with a specified density, or specify them fully connected. You can also modify the layers at any time without redefining the entire network.

The learning rule at each layer is programmable. Inputs include raster scan files and ASCII files. The program offers scatter diagrams of

continued

training inputs and outputs.

A maximum of 4000 processing elements with a total of 16,000 connections are provided. On an IBM PC AT with an 80287 math coprocessor, a maximum of 32,000 connections per second can be made.

NeuralWare also sells Solution Packs, a tutorial tool that lets you examine Rosenblatt's classic Perceptron neural model and Hopfield's Cross-Bar Associative Network.

NeuralWorks runs on IBM PCs or compatibles with at least 512K bytes of RAM and a graphics monitor.
Price: $99; Solution Packs, $49.
Contact: NeuralWare Inc., 103 Buckskin Court, Sewickley, PA 15143, (412) 741-7699.
Inquiry 578.

NetWurkz for the IBM PC is a neural-network tutorial. It models associative memory to find the nearest match to your input word. The emulator is limited to about 1000 neurons. The program comes with a PL/D compiler (NetWurkz is embedded within the PL/D language as data statements). The program also comes with source code.

To run NetWurkz, you need an IBM PC, XT, AT, or compatible with at least 256K bytes of RAM.
Price: $79.95.
Contact: DAIR Computer Systems, 3440 Kenneth Dr., Palo Alto, CA 94303, (415) 494-7081.
Inquiry 579.

Turn Your AT into a Neurocomputer

The Anza coprocessor board from Hecht-Nielsen Neurocomputer Corp. transforms any IBM PC AT or compatible into a neurocomputer that's capable of implementing a neural network. The Anza uses a 68020 processor and a 68881 floating-point coprocessor, along with 4 megabytes of one-wait-state RAM.

The VAXstation 2000 displays 1024- by 864-pixel color.

The system can implement neural networks containing up to 30,000 processing elements (neurons) with up to 480,000 interconnects. It can update the interconnects at 25,000 interconnects per second during learning and at 45,000 interconnects per second in feed-forward mode.

Software supplied with the Anza includes the User Interface Subroutine Library (UISL) and five Basic Netware Packages. The UISL is a collection of instructions that provide access to all Anza functions from within programs written in C, Pascal, FORTRAN, and BASIC. Each of the five Basic Netware Packages is a generic, user-configurable implementation of a basic network paradigm specifying the interconnection structure of the network and the form of the differential equations that determine the behavior of the individual processing elements. You can customize the Netware Packages to fit specific applications by modifying the number of neurons, their initial state and weight values, learning rates, and time constants.

The Anza is available both as a board/software package alone or bundled with a 10-MHz Zenith Z-248 AT-compatible with a 20- or 40-megabyte hard disk drive, an EGA board, and a monitor. In addition, the company offers three different training courses on working with neural networks.
Price: Board alone, $9500; with Z-248 and 20-megabyte hard disk drive, $14,950; with Z-248 and 40-megabyte hard disk drive, $18,950.
Contact: Hecht-Nielsen Neurocomputer Corp., 5893 Oberlin Dr., San Diego, CA 92121, (619) 546-8877.
Inquiry 581.

Low-Cost Color VAX

Digital Equipment Corp.'s VAXstation 2000 is a four-plane workstation (i.e., it has 16 simultaneous colors) with graphics resolution of 1024 by 864 pixels. The system's processor is the MicroVAX II chip set, and its proprietary graphics chip set is the same one used in the VAXstation II/GPX.

Two versions are available. The entry-level system includes the MicroVAX II chip set running at 20 MHz with a floating-point unit, 4 megabytes of RAM, a built-in Ethernet adapter, three-button mouse, keyboard, 15-inch color monitor, and software. A 42-megabyte hard disk driver is also available.

The advanced system includes a 19-inch color monitor. All systems include one-year on-site warranty service.
Price: Entry-level version, $4600; with 19-inch monitor, $5400; with hard disk drive, $10,950.
Contact: Digital Equipment Corp., The Mill, Maynard, MA 01754-2571, (617) 897-5111.
Inquiry 580.

A Disk Named Patrick Henry

Patriotic themes abound in a company named 1776 Inc. Case in point: Patrick Henry, a high-capacity hard disk–caching system with an average access time that the company claims is between 0.5 and 7 milliseconds, depending on system configuration. Tuning software included with the system lets you increase its performance by adjusting the cache to the application you're using; it guarantees that critical files will always be found in the cache when needed.

The system uses SCSI for connecting to the host and ESDI (enhanced small device interface) for intercommunicating among drives within a multidrive system. Data is transferred to the host at 1.2 megabytes per second. A 68000 processor provides intelligence for the system. Patrick Henry is compatible with MS-DOS, Novell Advanced Netware, and MS-DOS networks. The company has plans for Unix and Xenix compatibility in the near future.

Patrick Henry's built-in fault tolerance automatically reallocates disk space when bad sectors are suspected. It also keeps duplicate copies of the directories and file-allocation tables. The system's security features let you divide the disk into up to 256 password-protected sections.

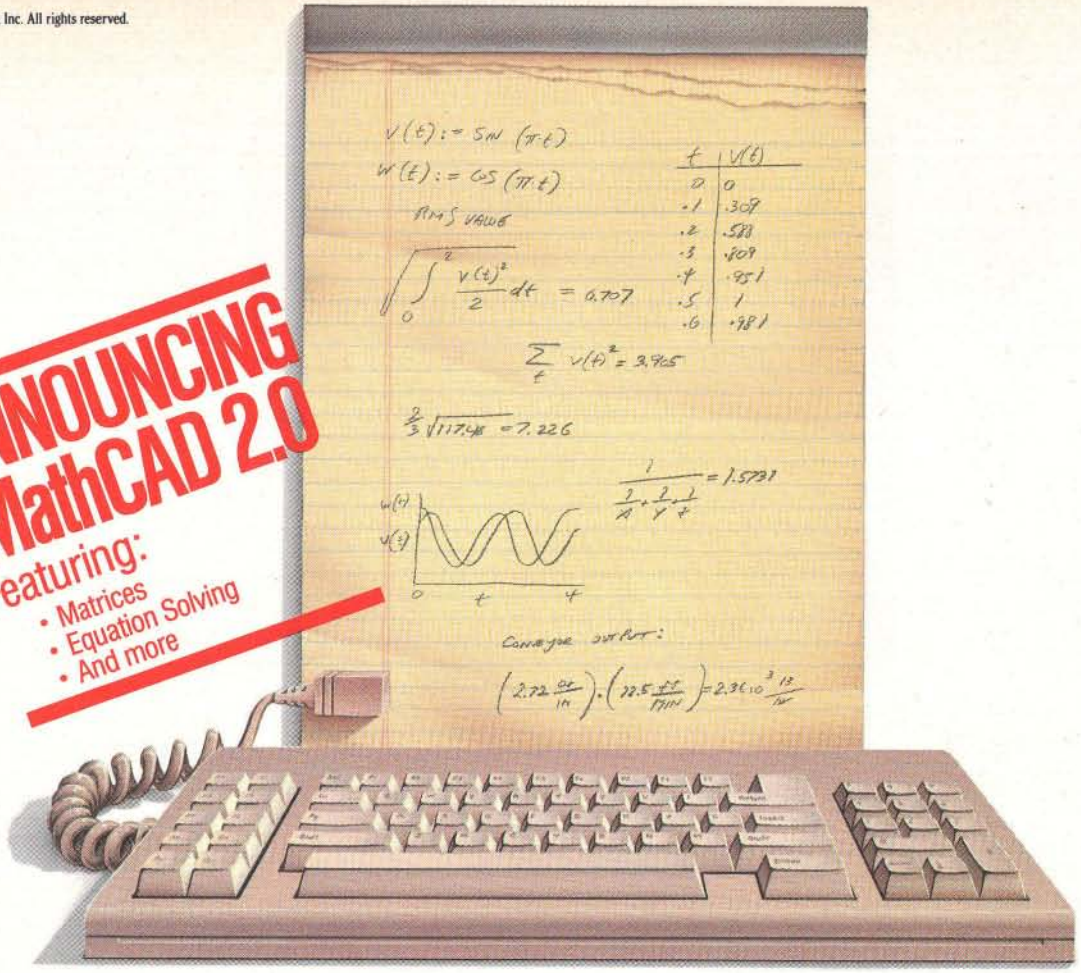
Systems are available in capacities ranging from 70 megabytes to 1280 megabytes, with cache sizes from 512K bytes to 16.5 megabytes. Tape backup is available in 60- and 120-megabyte sizes.
Price: $9900 to $64,700.
Contact: 1776 Inc., 4522 Murietta Ave., Suite 700, Sherman Oaks, CA 91423, (818) 789-2004.
Inquiry 582.

continued

ANNOUNCING MathCAD 2.0

Featuring:

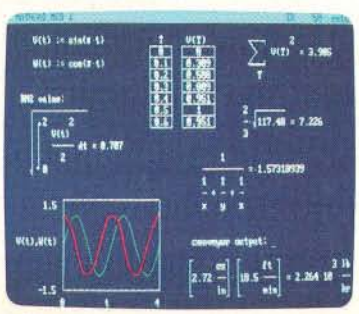
- Matrices
- Equation Solving
- And more



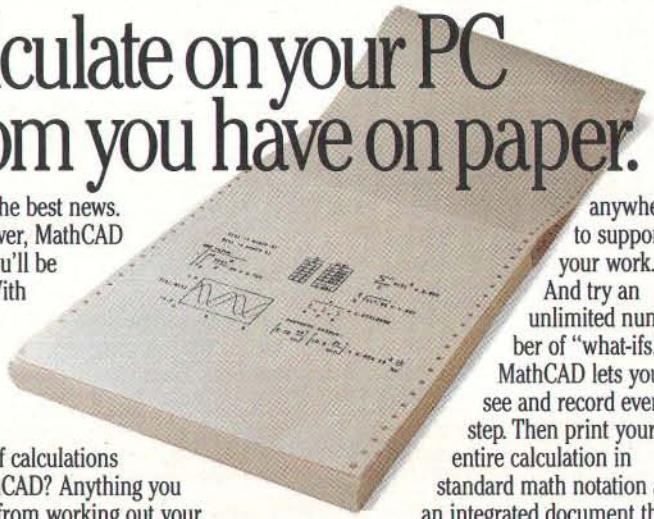
Now you can calculate on your PC with the same freedom you have on paper.

MathCAD.™ The first software that lets you do calculations on your PC as simply as on a scratchpad. Just define your variables and enter your formulas anywhere on the screen. MathCAD not only formats your equations as they're typed, it instantly calculates the results, and displays your work in real math notation.

But MathCAD is more than an equation solver. In addition to the usual trigonometric and exponential functions, it includes built-in statistical functions, cubic splines, Fourier transforms, Bessel functions, and more. It also handles complex numbers and unit conversions in a completely transparent way.



And here's the best news. Even with all this power, MathCAD is so easy to learn, you'll be using it in an hour. With MathCAD you can concentrate immediately on your problem, not your computer.



What kind of calculations can you do with MathCAD? Anything you have a formula for—from working out your mortgage payments to solving a heat transfer problem, or modeling electrical circuit parameters.

You can display your results as numbers, tables, or graphs, and combine them just like you do on paper. Add text anywhere to support your work. And try an unlimited number of "what-ifs." MathCAD lets you see and record every step. Then print your entire calculation in standard math notation as an integrated document that anyone can understand.

Why spend another minute doing calculations by hand or writing and debugging programs? Put MathCAD to work for you now. Call today for further information and the name of a MathCAD dealer near you.

New features in MathCAD 2.0

This major MathCAD upgrade includes such new features as: built-in equation solver • full matrix operations • two- to four-times increase in calculation speed • easier full-page text processing • auto-scaled plots • memory enhancements • additional printer and plotter support • and more. Call for detailed spec sheet.

Circle 164 on Reader Service Card

1-800-MathCAD

(In Massachusetts: 617-577-1017)

MathCAD

MathSoft, Inc., 1 Kendall Sq., Cambridge, MA 02139

Requires IBM PC® or compatible, 512KB RAM, graphics card.
IBM PC® International Business Machines Corporation.
MathCAD™ MathSoft, Inc.

NEC Upgrades Laptop Screen

The NEC MultiSpeed EL is an upgraded version of the NEC MultiSpeed laptop computer. As its name implies, it now has an electroluminescent, backlit, supertwist LCD screen. The screen provides you with a full 80 characters by 25 lines with an aspect ratio of 1.6 to 1 and a resolution of 640 by 200 pixels.

Also new on the MultiSpeed EL are brightness and contrast controls on the screen panel, a friction lock that holds the screen at the angle you choose, on/off switching of LCD backlighting, and automatic screen power-off. NEC claims a battery life of 4 hours.

If you own an original NEC MultiSpeed, you can upgrade your system to the new screen. Some early serial numbers have to be returned to the factory for upgrade. The rest can be upgraded either by the owner or by your local dealer.

Price: $2500; screen upgrade, $499.
Contact: NEC Home Electronics, 1255 Michael Dr., Wood Dale, IL 60191, (312) 860-9500.
Inquiry 583.

NEC adds an electroluminescent screen to the MultiSpeed.

Artificial Intelligence Applied to Statistical Forecasting

Forecast Pro is an expert-system time-series forecasting program from Business Forecast Systems, the company that released Forecast Master. BFS reports that with Forecast Pro, prior knowledge of statistics is not necessary.

Artificial intelligence is used to guide you through a series of steps, or modules, that make up the forecasting process. Techniques include exponential smoothing, Box-Jenkins, and dynamic regression. The expert-system analysis feature performs statistical tests on the data and determines the characteristics and the power of potential explanatory variables or leading indicators. The system then describes the data statistically, recommends an appropriate method, and explains its reasoning.

Once you've chosen the forecasting procedure, automatic fitting options let you choose and optimize the model parameters. The program presents and interprets fitting diagnostics and can suggest a route to improve the model. You can also make your own decision at any time.

A set of diagnostic screens helps you compare different models. Other features include a full-screen time-series editor, graphics, user-defined variables, color capability, and batch-processing capability. The graphics facility lets you compare several forecasts and time series on the same plot with scaling options. You can output them to a variety of graphics devices or save them for interactive editing.

BFS is directing the program toward academic use as much as general business applications.

Forecast Pro runs on IBM PCs, XTs, ATs, and compatibles with at least 512K bytes of RAM and two disk drives. It also runs on the IBM PS/2 series and supports VGA graphics. An Intel math coprocessor chip is recommended.

Price: $495; academic price, $195.
Contact: Business Forecast Systems Inc., 55 Wheeler St., Cambridge, MA 02138, (617) 354-3745.
Inquiry 584.

Low-Cost PC-Based Telephone Management

BigmOuth from Talking Technology is a digital recording and telephone management system for IBM PCs and compatibles. It consists of a half-length card, software, telephone cables, and an external speaker.

BigmOuth's features include basic answering-machine capabilities and personal messaging, which gives users private mail boxes. The system can store up to 1000 messages, and you can retrieve them either locally or remotely from any Touch-tone telephone. The unit can also forward messages to other telephones and deliver messages at a prearranged time.

Software that comes with BigmOuth includes an autodialer with a database and an automatic activity log. All messages and hang-ups are stamped with the time, date, and a description of the activity.

To use BigmOuth, you need 256K bytes of RAM and at least two floppy disk drives, although a hard disk drive is recommended. Talking Technology also offers a licensing program for developers who want to integrate BigmOuth's voice features into their software.

Price: $239.
Contact: Talking Technology Inc., 6558 Lucas Ave. #301, Oakland, CA 94611, (415) 339-8255.
Inquiry 585.

Updated Dot-Matrix/ Daisy-Wheel Combo

Brother International's latest incarnation of its Twinriter—the Twinriter 6—combines faster dot-matrix and daisy-wheel printheads side by side in the same printer. The unit's daisy-wheel element prints at 36 characters per second, while the dot-matrix part of the system prints at 200 cps. The twin heads allow true letter-quality text and graphics to be mixed on the same page.

The Twinriter 6 prints up to 36 columns bidirectionally and supports the IBM extended character set in both letter-quality and draft modes. Options include a forms tractor, a single-bin sheet feeder, and a triple-bin sheet/envelope feeder. A parallel Centronics interface is standard, and an RS-232C serial interface is available.

Price: $1395; forms tractor, $169; single-bin sheet feeder, $325; triple-bin sheet feeder, $599.
Contact: Brother International Corp., 8 Corporate Place, Piscataway, NJ 08854, (201) 981-0300.
Inquiry 586.

continued

THE WORLD'S SMARTEST ANSWERING MACHINE

PERSONAL VOICE MAIL
"Hello. I'm not available right now. Please wait for the tone and leave a detailed message. Touch the star to listen to what you've recorded."

PERSONAL MESSAGES FOR FREQUENT CALLERS
"Hello, I'm not ...[2]... Dad! I'm not here, but my computer knows exactly where I am and will pass your message on to me immediately. Wait for the tone and tell me where you are. I'll call you right back."

REALLY PERSONAL MESSAGES FOR FREQUENT CALLERS
"Hello, I'm not avai ...[2]... Anne! Sweetheart! I'm in the car, picking up your flowers. My car phone number is 993-1234 if you need me. Otherwise, see you at seven. Kiss-kiss-kiss!"

MESSAGE FORWARDING
"Hello. This is your answering machine calling...[2]... Three new messages. Message one was received at 3:52PM today."

MULTIPLE VOICE MAIL BOXES
"Hi. This is the operating systems group. We're out to lunch, but you can leave a private message by dialing 11 for Diane, 12 for June, 13 for Joel and 14 for Bob. Or you can wait for the tone to leave a message for our secretary."

INCREASED SECRETARIAL PRODUCTIVITY
"This is Gene's voice mailbox. Please wait for the tone and leave a message. My computer knows where I am at all times and will call me immediately with your message. If you need to speak to someone right away, touch zero to transfer to my secretary."

DON'T FORGET MOM!
"This is Chip. Please ...[2]... Hi, Mom. I've been waiting for your call. How's Europe? Thanks for remembering my birthday. Sorry I missed you, but I had to run some errands. See you Thursday at the airport."

OUTGOING MESSAGES
"This is Joel's computer calling. Just a reminder for Lynne and Rick — We have a budget review tomorrow morning at 8:00 o'clock. See you there."

Answering machines are irritating because they are so dumb. Even the best of them. For only $349, we'll give you personal voice mail for your PC, and turn it into the world's smartest answering machine. All without disturbing whatever else you've been doing on the PC.

How smart is "smartest?" The examples above . . . uh . . . speak for themselves. Sure, your PC can answer the phone in your voice, and let you retrieve messages remotely from any touch-tone phone. And it can call you to deliver your messages.

But give your friends and associates their own voice mailboxes. The ability to interrupt your greeting and start recording immediately. To deliver messages to each other as well as to you. The ability to transfer to other extensions. Even let them change their minds *and* their messages. Give them all this and you'll never again have to apologize for making people talk to a machine.

In your business, it will relieve your secretary of the burden of taking routine messages. And relieve you of the burden of transposed telephone numbers. In business or in personal use, it works 24 hours a day. Without irritating your callers like mere answering machines do. All while you're running your spreadsheet, word processor or just about anything else.

We call the world's smartest answering machine "CAM." For *Complete Answering Machine*. We call ourselves The Complete PC. And CAM is just the beginning of a whole line of smart products designed to help you get *more from your personal computer.*

You should call (800) 634-5558 today for the name of the CAM dealer* nearest you.

So tomorrow, you can give your old answering machine to someone who doesn't mind annoying people.

THECOMPLETEPC

More from your personal computer

521 Cottonwood Drive • Milpitas, California 95035
408 434-0145 • 800 634-5558 • FAX 408 434-1048

***CAM is available now from: R+R Direct (800-654-7587) • Radio Shack (Cat. No. 90-2137)**

Circle 55 on Reader Service Card

AI Development Environment

KnowledgePro, an artificial intelligence programming environment, includes hypertext capabilities, rules, and a list-processing language. Its hypertext capabilities enable you to present information in nonlinear form. You can display a screen of text with certain words or phrases highlighted, and the reader can follow that train of thought to other screens, which may also have highlighted phrases. You can also program any set of instructions (i.e., rules) or areas of the knowledge base to be activated when the reader selects specified concepts.

A "topic" organizes information into conceptual units containing a hierarchical structure. Each predefined command acts like a built-in topic, and each topic you write behaves like a system command. Topics include name, contents, descriptions, and machinery; and each can behave like a frame, object, function, command, or variable.

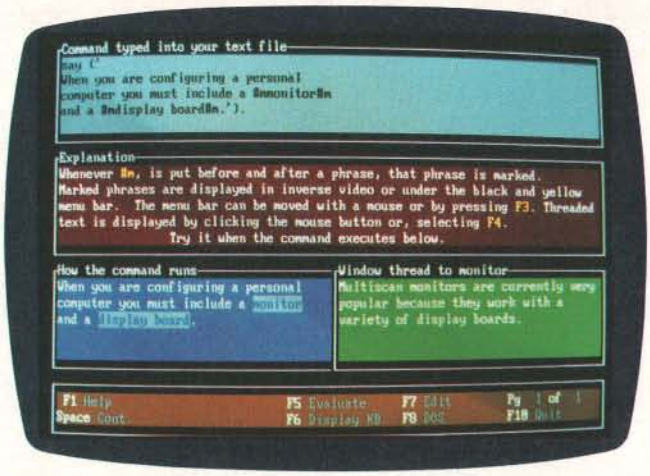
KnowledgePro lets you use rules and commands to manipulate words or word lists, change window colors, perform calculations, and access external files.

The program includes macro capabilities, a built-in text editor, mouse support, and sample knowledge bases.

Knowledge Garden used its KnowledgePro environment to create KnowledgeMaker, an induction program. It can extract IF. . . THEN rules from raw data and convert the rules into Turbo Prolog, Insight 2+, M.1, MicroExpert, and KnowledgePro formats.

KnowledgeMaker accepts data from Lotus 1-2-3 and databases and outputs IF. . . THEN statements, or you can use data from other programs and output rules in English. Lotus 1-2-3 files are read without an interface or conversion procedure.

Both KnowledgeMaker and KnowledgePro run on IBM PCs, XTs, ATs, and compatibles with MS-DOS or PC-DOS 2.1 or higher, 512K bytes of RAM, and two floppy disk drives, although the company recommends a hard disk drive. KnowledgePro also comes with source code, and it is not copy-protected.
Price: KnowledgePro, $495; KnowledgeMaker, $99.
Contact: Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123, (518) 766-3000.
Inquiry 587.



Hypertext in operation as part of KnowledgePro.

Microsoft Announces Works for the PC

PC-Works combines word-processing, spreadsheet, database, reporting, charting, and communications modules, along with graphics, a spelling checker, and macros. You can copy data between modules or receive information over the communications module and place it in another module.

The word-processing module is basically Word 2.0, according to Microsoft, but without the style sheets, glossaries, divisions, and multiple columns. It has an undo command and a mailing-label facility, and it features the same font support and printer drivers as Microsoft Word.

The spreadsheet, which has 256 columns by 4096 rows, functions like Lotus 1-2-3. It offers names, macros, and freeze-title capabilities. PC-Works does not include such Lotus 1-2-3 features as tables, distribution ranges, automatic series, and label-range justifications, but it does provide numeric alignment, cell printing styles, and the ability to print in different fonts.

The charting interface, which is also similar to that of 1-2-3, lets you chart worksheets with overlapped bars and line charts with different scales. Eight graph types are included.

With the report module, you can break up reports into three levels and perform several statistical functions, including cumulative or noncumulative functions over any break level. Summary reports are also an option.

The in-memory and nonrelational database allows 4096 records and 256 fields and features form and list views. Also allowed are calculated fields, Boolean logic, and three concurrent sorts.

The program runs in character mode rather than graphics mode in all modules except charting. PC-Works uses pull-down Windows-like menus, and the mouse is supported for selection, scrolling, and command or dialog item selections. Communications facilities include autologon, VT-100, and Xmodem.

PC-Works is designed to run on 8086/8088 IBM PCs and compatibles with 512K bytes of RAM, two 360K-byte floppy disk drives or one 720K-byte drive, and a CGA or Hercules card. The program is not copy-protected.
Price: $195.
Contact: Microsoft Corp., P.O. Box 97017, Redmond, WA 98073-9717, (206) 882-8080.
Inquiry 588.

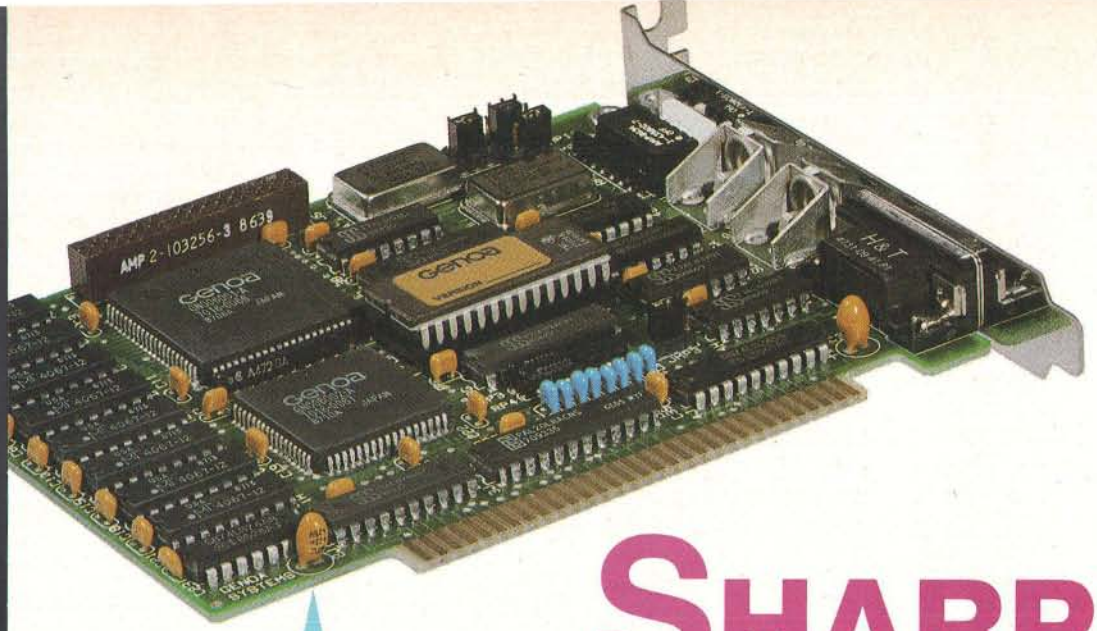
C Library

C-Worthy from Solution Systems is a C library that works with most C compilers. The program-callable subroutines and development utilities automate program-development tasks.

Screen display of text, error messages, and help screens are held in separate files. Windowing facilities make use of virtual screens as well as physical screens. Keyboard-handling routines offer text windows that describe the next step. A word-wrapping text editor is featured, along with pop-up, Lotus-style, and Windows-style menus. Error checking is done automatically with a call to a single library routine. A DOS interface acts as the interface to the operating system and takes care of such functions as setting date and time through the locking of a variable-length record in a file.

Solution Systems reports that C-Worthy runs on IBM PCs and compatibles, PS/2 machines, and incompatible MS-DOS–based systems.
Price: $295; $495 with source code.
Contact: Solution Systems, 541 Main St., Suite 410, South Weymouth, MA 02190, (800) 821-2492; in Massachusetts, (617) 337-6963.
Inquiry 589.

continued



SHARPEN YOUR IMAGE

800 x 600 EGA

- *100% Multisync Compatible*
- *CGA DoubleScan (just like IBM's new VGA!)*
- *Drivers for AutoCAD, Windows, GEM, Ventura, Pagemaker and more.*
- *100% IBM EGA Compatible*
- *132 Column Drivers for Lotus 1-2-3 and Symphony*
- *80 x 66 for Desktop Publishing*

CAD/CAM

DESKTOP PUBLISHING

*Genoa's SuperEGA™ board is the easiest way to get the best out of your high-resolution monitor—and the popular CAD/CAM and desktop publishing programs. And, SuperEGA also supports CGA, CGA DoubleScan (to 640 x 400), MDA, Hercules, and EGA, thanks to Genoa's exclusive AutoSync™ capability. So now you can get **high performance at a reasonable cost**—and look sharp!*

Genoa SYSTEMS CORPORATION

73 E. Trimble Road, San Jose, CA 95131
FAX: 408-434-0997 Telex: 172319
Telephone: 408-432-9090

Circle 112 on Reader Service Card

Under-$2000 80386 System

Advanced Logic Research's 80386 product line includes the ALR 386/2 Model 10, a $1990 system. The Model 10 includes 1 megabyte of 32-bit 80-nanosecond RAM, expandable to 2 megabytes on the system board. Also included is a single 1.2-megabyte floppy disk drive, single serial and parallel ports, and a Phoenix BIOS.

In addition to the entry-level Model 10, the 386/2 is available as Models 40, 80, and 130, with hard disk drives of corresponding capacities. All have 2 megabytes of RAM and a hard disk controller that features 1-to-1 interleave and on-board caching.

All models of the 386/2 come with 101-key keyboards and eight full-length expansion slots: two 32-bit, four 16-bit, and two 8-bit. Optional accessories include an EGA and a high-resolution color monitor.

Price: $1990; with 40-megabyte hard disk drive, $3990; with 70-megabyte drive, $4690; with 130-megabyte drive, $7299.
Contact: Advanced Logic Research Inc., 10 Chrysler, Irvine, CA 92718, (714) 581-6770.
Inquiry 590.

High-Speed, Low-Cost Workstation

Sun Microsystems' Sun-3/60 is a 68020-based Unix system that runs at 3 million instructions per second (MIPS) and can be expanded to 24 megabytes of main memory. The company claims that using the Dhrystone benchmark, the 3/60 performs at approximately three times the speed of the VAX-11/780.

In addition to the 20-MHz 68020, the 3/60's standard configuration includes a 68881 floating-point co-

The Sun 3/60 runs at 3 MIPS and can take 24 megabytes of RAM.

processor, 4 megabytes of 200-nanosecond RAM, two RS-423C serial ports, an SCSI port, and both standard and thin-cable Ethernet interfaces. Mass storage options include 71- or 141-megabyte hard disk drives and a 60-megabyte tape-backup unit. Also standard is an optical mouse.

Both color and monochrome display options are available, including three monochrome monitors with resolutions of up to 1600 by 1280. Both 16-inch and 19-inch color monitors are available, with 1152- by 900-pixel by 8-bit resolution, along with a monochrome plane.

In addition to the Unix operating system, the 3/60 includes the SunPro programming environment, the SunView window-management and interface-development system, and the SunCore and SunCGI graphics libraries. Also available is the SunGKS graphics library, as well as C, FORTRAN-77, Pascal, and Modula-2.
Price: Entry-level diskless system, $4995; with 141-megabyte hard disk drive and tape backup, $12,400.
Contact: Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, CA 94043, (415) 691-1300.
Inquiry 591.

Heavy-Duty AT-Compatible

Designed for withstanding hazards and harsh environments, the Heath/Zenith SW-3000 is an IBM PC AT–compatible, 80286-based system that operates at 8 MHz with no wait states. The system's standard features include 512K bytes of RAM, a single 1.2-megabyte floppy disk drive, and a 20-megabyte hard disk drive. A socket for an optional 80287 numeric coprocessor is included as well.

Other standard features of the SW-3000 include serial and parallel ports, six expansion slots, and a video card that supports monochrome display adapter–, CGA-, EGA-, and Hercules-compatible displays.

The SW-3000 can be rack-mounted for laboratory or production-area use. A filtered fan maintains positive air pressure within the cabinet to keep dust and dirt from entering, and the keyboard is impervious to dust, dirt, and liquids.

Along with the computer, you'll need an SW-3010 Industrial Monitor, a 13-inch EGA-compatible monitor that supports dual-scan frequency outputs of 15.75 kilohertz and 21.8 kHz for resolution of up to 640 by 350 pixels. The monitor is housed in a metal cabinet, and, like the computer, it has a filter-equipped fan that maintains positive air pressure. It's also rack-mountable.
Price: SW-3000, $4500; SW-3010, $900.
Contact: Heath/Zenith, Computer-Based Instruments, Hilltop Rd., St. Joseph, MI 49085, (616) 982-3200.
Inquiry 592.

TI Upgrades Explorer

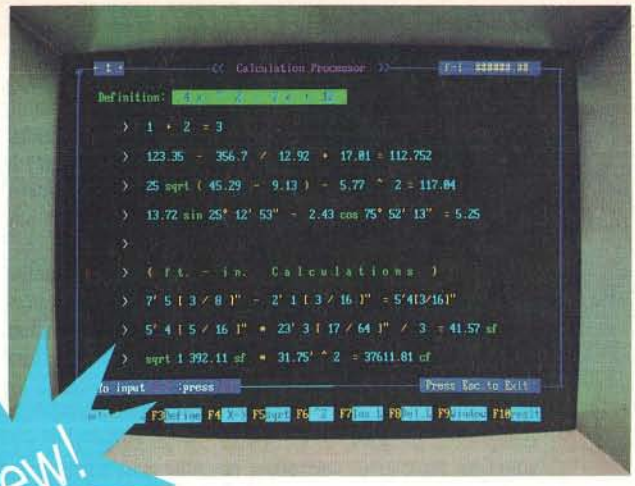
Texas Instruments' Explorer II system is built around TI's proprietary 32-bit Explorer Lisp microprocessor. The company claims the system provides more than 5 times the performance of previous Explorer systems. The Explorer Lisp microprocessor integrates 60 percent of the original two-board Explorer processor onto a single custom chip, packing more than 553,000 transistors into a 1-square-centimeter area, more than 2.5 times as dense as the 68020. Pipelined architecture provides execution of microinstructions and many of the more complex Lisp macroinstructions in a single clock cycle.

The Explorer II system integrates Lisp and Unix by combining an Explorer II processor with a 68020 processor running Unix System V. The Explorer II processor comprises the Explorer Lisp Microprocessor, 32,000 words of writable control store, and two high-speed cache memories.

The system includes a three-button mouse and a 17-inch monochrome monitor with 1024- by 808-pixel resolution.

Owners of the original Explorer systems can upgrade their systems with the Explorer II processor kit.
Price: $49,900 to $99,900; processor upgrade, $20,000.
Contact: Texas Instruments Inc., Data Systems Group, P.O. Box 809063, DSG-141, Dallas, TX 75380-9063, (800) 527-3500.
Inquiry 593.

continued



■ Data Processing ■ Word Processing ■ Info. Processing.
And Now. The Wheel Calculation Processor.
There's absolutely nothing like it on the market today.

The full power of the IBM PC and the extraordinary ease of a calculator. Full screen operations and editing with text remarks. On-screen guidance. Create your own files library. *For the first time, it's all in your language.* You see what you're doing and you're doing what comes naturally. You're rolling along the moment your fingers touch the keys. The Wheel is so easy to use, you don't even have to open your user's guide.

New!

the WHEEL CALCULATION PROCESSOR™

The First and Only!

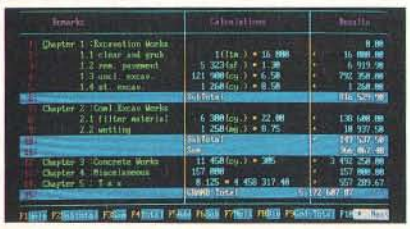
Kiss your calculator good-bye!

A remarkable new concept as simple as the wheel

the DAILY WHEEL

List price: $99.95
Now $59.95

Calculation Processor (Pop-up★)
■ Arithmetic calc. ■ Ft.-inch calc.
■ Repetitive calc. ■ And much more!
Unit Conversion (Pop-up★)
Length, Area, Volume, Weight, Angles, Temperatures.
Calculation Editor



the SCIENTIFIC WHEEL

List price: $99.95 **Now $59.95**

Scientific Calculation Processor (Pop-up★)
■ Mathematical calculations using built-in log., trig., hyperbolic functions. ■ Repetitive calculations with one variable and predefined multi-variable functions and constants.
Unit Conversion (Pop-up★)
Length, Area, Volume, Weight, Angles, Temperatures, Base N.
Function Analysis [y=f(x)]
On one screen, fully interactive, easy:
■ Solving (x=0; y=0) ■ Analyzing max. and min. ■ Calculating f(x), derivatives (y') and integrals ■ Plus full-screen graphs.

★ **Pop-up:** Memory resident service programs, operating with all major software.

System requirements ■ For IBM PC/XT/AT or fully compatibles.
■ PC-DOS (MS-DOS) 2.0 or later. One floppy drive. 256K for Daily/Scientific; 384K for Professional. For graphics: CGA, EGA or Hercules or fully compatibles.

Introductory offer – good through Oct. 30, 1987.

Not copy protected.

30-Day Money Back Guarantee.

Additional discount for bulk orders.

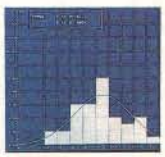
Call our main office today!

*Add shipping charge: $5 - California residents: add sales tax.

the PROFESSIONAL WHEEL

List price: $199.95
Plus FREE!
Now $158.95
Special Introductory Offer:
The Scientific Wheel. FREE!

Calculation Editor
All features of Daily Wheel Editor plus sophisticated, easy-to-use file library organizer.
Function Calculations
Create your own functions and constants library, including notes and use it to make your calculations easier, faster and more accurate.
Extended Unit Conversion
Length, Area, Volume, Weight, Angles, Temperature, Velocity, Flow, Density, Viscosity, Pressure, Power, Energy.
Statistical Analysis
Fully interactive processing in your natural environment. Designed by engineers for scientists, engineers and other professionals.



Plus, **Print-Outs** for reports and **Files**: easy file library organizer, Save/Load, rename, delete, etc.

Visa and Master Card only.

Get Rolling Right Now!
Call: 800-533-9533

dalin inc.
applications software

16421 Clymer Ave., Granada Hills
Calif. 91344. Tel: (818) 360-7058

Circle 76 on Reader Service Card

PERIPHERALS

Floppy Disks with 5.5 Megabytes

Based on Kodak's 6.6-megabyte high-density floppy disk drive, the Pelican 6.6 stores 5.5 megabytes (formatted) of data on special Verbatim floppy disks. The Pelican includes a high-speed controller card with 512K bytes of its own cache memory. By buffering data to and from the drive, the cache gives the system an effective access time of 85 milliseconds.

The drive uses hard disk–type head positioning and stores 384 tracks per inch. Data-transfer speed is 500,000 bits per second. The Pelican will read from (but not write to) 3.3-megabyte, 1.2-megabyte, and 360K-byte disks.

Both an internal mount and an external Pelican are available. The internal Pelican fits into any half-height slot and uses the computer system's internal disk drive. The external model, which has a 2¼-inch-wide footprint, has its own power supply and cooling system.

Price: Internal, $695; external, $895; disks, approximately $20 each.
Contact: Pacific Micro Systems, 160 Gate 5 Rd., Sausalito, CA 94965, (415) 331-2525.
Inquiry 594.

High-Speed Daisy-Wheel Printer

Primages' 90-GT is a daisy-wheel character printer that prints at 90 characters per second. The printer has a ribbon-sensing system that automatically shuts it down if a ribbon breaks.

The company offers several 100-spoke wheels in a wide variety of type styles. Each wheel is capable of printing in 12 languages. Sheet and envelope feeders are also available.

The Pelican 6.6 stores 5.5 megabytes on a special floppy disk.

Price: $1095.
Contact: Primages Inc., 151 Trade Zone Dr., Ronkonkoma, NY 11779, (516) 585-8200.
Inquiry 595.

Desktop Modem Uses MNP

With the introduction of its MultiModem212E, MultiTech Systems has added hardware-based MNP error-detection and retransmission protocol to its 300-/1200-bps desktop modem.

The Hayes-compatible MultiModem212E can operate both synchronously and asynchronously. It can be set to run with or without MNP or to auto-detect MNP. According to the company, use of MNP will pass up to 10 percent more data through a connection in a given period of time.

Price: $399.
Contact: MultiTech Systems, 82 Second Ave. SE, New Brighton, MN 55112, (800) 328-9717; in Minnesota, (612) 631-3550.
Inquiry 596.

High-Speed Personal Laser Printer

The Model L1012 Personal Laser Printer is a 12-page-per-minute unit from Printronix. It emulates the HP LaserJet Plus, the Diablo 630, and the Epson FX-80 and comes with nine typefaces, each available in both normal and bold.

Toner life is 2000 pages, developer and drum life is rated at 15,000 copies, and the optical filter and fusion unit has a rated life of 45,000 copies. The printer is shipped with Quickset, a configuration software package.

Price: $3495.
Contact: Printronix, 17500 Cartwright Rd., P.O. Box 19559, Irvine, CA 92713-9559, (714) 863-1900.
Inquiry 597.

Overhead Palette Shows Color

Telex Communications' MagnaByte 5220-I is a computer-interfaced LCD for overhead projectors that has a new twist: color. The display takes the color output from an IBM PC or compatible and turns it into an approximate LCD color image for overhead projection. It will also work with monochrome-only systems, projecting graphics in deep blue and yellow.

No special software is required for the MagnaByte. It comes complete with an LCD screen, a full-length plug-in board, and a slide-projector–like remote control. The display weighs 6½ pounds and is fan-cooled.

Price: $1580.
Contact: Telex Communications Inc., 9600 Aldrich Ave. S, Minneapolis, MN 55420, (612) 884-4051.
Inquiry 598.

Shadow Boasts Redundant Disks

The Shadow is a high-capacity redundant data-storage system designed for use with IBM PC ATs and compatibles, the Macintosh, and Digital Q-Bus–based systems.

Consisting of dual 86-megabyte or 170-megabyte hard disk drives, the Shadow also has two separate controllers and two separate power supplies. All data is simultaneously written to both disks.

If either a disk, controller, or power supply fails, the data continues to be read from and written to the other disk with no interruption and no loss of data.

The company reports that the average access speed is under 30 ms.

Price: Dual 86-megabyte drives, $4395; dual 170-megabyte drives, $5995.
Contact: Century Data Systems, Ford/Higgins Division, 1301 South Sunset St., Longmont, CO 80501, (800) 262-6743; in Colorado, (714) 999-2664.
Inquiry 599.

TurboVision Offers Big-Screen View

AST Research's TurboVision is a combination high-resolution graphics board and high-resolution full-page monitor designed primarily for desktop-publishing applications with IBM PCs, XTs, ATs, and compatibles.

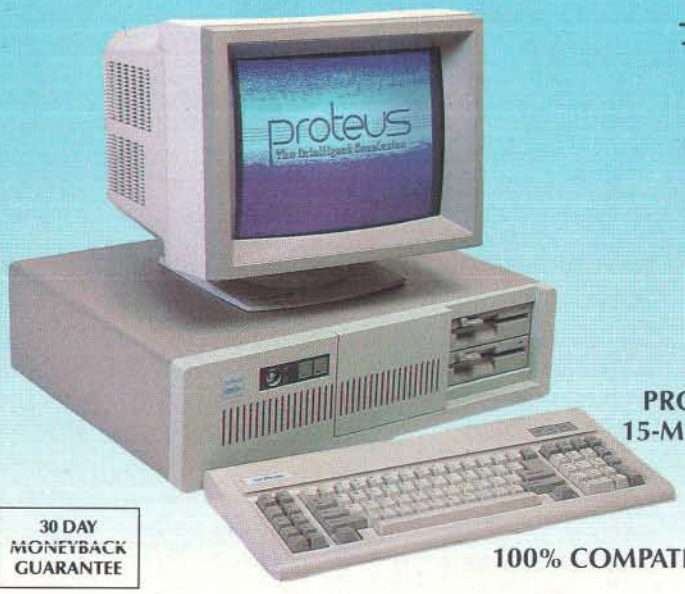
TurboVision's 15-inch full-page display has a resolution of 1024 by 1280 (108 pixels per inch) and uses "paper-white" phosphors. The monitor has a 107-MHz bandwidth, a 79.6-kHz scan rate, and a 60-hertz noninterlaced refresh rate.

Price: $1995.
Contact: AST Research, 212 Alton Ave., Irvine, CA 92714, (714) 863-1333.
Inquiry 600.

continued

proteus™

There are plenty of compatibles but none can match PROTEUS in IBM Compatibility, Speed, Reliability, Support & Delivery.



PROTEUS SYSTEMS features:

16MHz, Zero Wait State, 32-bit RAM Keyboard, Software, & Hardware selectable CPU speed & Wait States ROM based advanced Diagnostics. Norton SI: 23.5 !!

Editor's Choice.
"There are so many nice aspects to Proteus and the company that makes it, there isn't enough room to cover them all."
Lawrence Oakley,
Business Computer Digest, 3/87

PROTEUS SYSTEMS ARE DESIGNED AND BUILT IN USA
15-MONTH FULL WARRANTY, LABOR & PARTS INCLUDED
FREE NATIONWIDE ON YOUR SITE SERVICE!
24 HOUR ONLINE CUSTOMER SUPPORT

30 DAY MONEYBACK GUARANTEE

100% COMPATIBILITY WITH DOS, UNIX, XENIX, AUTOCAD, NOVELL

CHOOSE FROM THESE BEST HIGH SPEED 386 AND 286 SYSTEMS

PROTEUS-386A
- 80386 Intel CPU 16 MHz. Norton SI: 23.5
- Zero Wait State, 64KB Cache
- Keyboard Selectable Speed and Wait state
- 1 Megabyte 32-bit RAM expandable to 4MB on system board
- 2 Serials, 1 Parallel Port
- ROM Based Diagnostics & Setup
- Onboard EGA Bios
- Coprocessor Support
- Hard Disk & Floppy Controller
- Clock, Cal., & battery backup
- 230W quality 110/220v power supply
- 1.2MB Floppy Drive, Choice of
- 3.5" Microfloppy
- Enhanced Keyboard
- 14" High Resolution Monitor
- Herc. compatible Mono graphics card
- 40Mb Fast Hard Disk installed

Price: $3995.00
40MB EGA System $4495.00

PROTEUS-386i
- 80386-16 Intel CPU, 16 MHz.
- 512KB 32-bit RAM expandable to
- 16MB on Two 32-bit Slots
- Keyboard Selectable Speeds
- **80387 Coprocessor Socket**
- Serial, & Parallels on mainbd.
- 230W, quality Power supply 110/220v
- Hard Disk & Floppy Controller
- 1.2MB Floppy Drive, choice of
- 3.5" microfloppy
- High Resolution Monochrome Monitor
- Herc. Compatible Mono adapter
- Enhanced Keyboard
- 40MB Fast Hard Disk Installed
- Custom Configurations available

Price: $3595.00
40MB EGA System $3995.00

PROTEUS-286E
- **Intel 80286, 6/8/10 MHz.**
- 1024K RAM on System board
- 8 I/O slots
- Coprocessor Socket
- Clock, Cal., Battery backup
- 195W 110/220v power supply
- Hard Disk & Floppy comb. controller
- 2 Serials, Parallel Ports
- 1.2MB Floppy Drive (reads both
- 1.2MB and 360K floppy)
- Maxiswitch AT Style Keyboard
- Herc. Compat. Graphics Adapter
- High Resolution Monochrome Monitor
- 20MB Seagate Hard Disk Installed

Price: $1780.00

"...Proteus 286e is a clear winner. We recommend it".
Infoworld, April 27, 87

PROTEUS-286F
- 10MHz ZERO Wait State System
- 80286-10, 8/10MHz Keybd Select.
- **1024 RAM.**
- 2 Serials & 1 Parallel Ports
- 8 I/O Slots
- Hard Disk & Floppy Controller
- Clock, Cal. & Battery
- 195W Power supply 110/220v
- 1.2MB Floppy Drive, reads 1.2MB
- and 360K floppy.
- Maxiswitch Keyboard

Price: $1450.00

WE HAVE THE LARGEST SELECTION OF HARD DISKS, MONITORS AND ADAPTERS AT THE LOWEST PRICES. WE CUSTOM CONFIGURE AND TEST THE SYSTEMS EXTENSIVELY FOR YOU.

HARD DISKS

20MB Seagate	$279
30MB Seagate	$575
30MB Rodime	$565
40MB Seagate	$649
42MB Miniscribe	$665
44MB Priam	$795
80MB Seagate	$985
140 Maxtor	$call
190 Maxtor	$call

MONITORS

High Resolution Monochrome	$109
14" Proteus Mono Monitor	$159
13" Color Monitor	$340
14" Proteus EGA Monitor	$449
NEC Multisync EGA Monitor	$569

ADD-ONS

Herc. Compatible Mono card.	$98
IBM Compatible Color card	$98
Proteus EGA, CGA, MDA card	$255
Vega Delux EGA card	$345
ATI Wonder Card	$call
80287-8 Coprocessor	$249
80287-10 Coprocessor	$369
80387 Coprocessor	$call
1200B Omnitel Modem	$109
2400B Omnitel Modem	$239
40MB Tape Backup int	$469
60MB & 120MB Tape Bckup	$call
3.5" 720K Floppy Dr	$175
360K Floppy Drive	$109

Terms: Visa/MC, COD, Prepayment with cash discount, University and Corporate POs accepted upon approval. Quantity discounts.

IBM is a trademark of International Business Machines Corp., all prices, terms subject to change

proteus™

The Intelligent Conclusion

To order or for information call us 1-800-782-8387

In New Jersey Call (201) 288 8629
Telex 510 601 0960

Proteus Technology Corp,
377 Route 17,
Airport 17 Center,
Hasbrouck Heights, NJ 07604

Circle 225 on Reader Service Card

When you want to talk computers..

ATARI COMPUTERS

Atari Computers

800 XL 64K Computer.....Call
65XE 64K Computer.....87.99
130XE 132K Computer.....139.00
520ST Monochrome System.....499.00
520ST Color System.....659.00

Atari 1040 Color System $859

Includes: 1040ST, 1 mb RAM with 3½" drive built-in, 192K ROM with TOS, Basic, ST language and color monitor.
New 520ST FM is in stock.....Call

ATARI SOFTWARE

Access
Leaderboard Golf.....24.99
Accolade
Fight Night.....19.99
Activision
Music Studio.....34.99
Antic
Cad 3-D.....32.99
Batteries Included
Paperclip w/Spellpack.....39.99
Degas Elite.....48.99
Infocom
Zork Trilogy.....44.99
Microprose
Top Gunner.....19.99
Silent Service.....24.99
Optimized Systems
Personal Pascal.....47.99
Origin Systems
Ultima 4 XL/XE.....39.99
Paradox
Wanderer (3-D).....27.99
Psygnosis
Deep Space.....34.99
Timeworks
Wordwriter ST.....48.99
VIP
Professional (GEM).....144.00

COMMODORE COMPUTERS

Amiga 500 System

Includes: Amiga 500 CPU, 1 MB, 1080 RGB Monitor, Amiga DOS, Mouse, Kaleidoscope **Call**

Commodore 128.....259.00
Commodore 128D.....529.00
Commodore 64C.....179.00
64C, 1541C, 1802C Package....599.00
128, 1571, 2002 Package.....759.00
128D, 2002 Package.....829.00

COMMODORE SOFTWARE

Activision
Gamestar Series.....(ea.) 28.99
Broderbund
The Print Shop.....29.99
The Toy Shop.....39.99
Commodore
Textcraft w/Graphic Craft.....59.99
Assembler.....79.99
Enhancer DOS 1.2.....14.99
Discovery Software
Marauder Back-up.....32.99
Electronic Arts
Deluxe Paint II.....97.99
Deluxe Print.....74.99
Instant Music.....34.99
Deluxe Video 1.2.....97.99
Infocom
Hitchhiker's Guide.....28.99
Micro Illusions
Dynamic-Cad.....349.00
Mindscape
Halley Project.....34.99
SAT Prep.....51.99
Micro Systems
Analyze Version 2.0.....119.00
Scribble.....66.99
On-Line/Comm.....46.99
Sublogic
Flight Simulator.....31.99
V.I.P.
V.I.P. Professional.....112.00

MS/DOS SYSTEMS

AT&T 6300.....from $1299.00
Compaq.....from 1699.00
IBM-PS-2 Model 30.....Call
IBM-AT Enhanced.....from 3499.00
Leading Edge.....from 999.00
NEC Multispeed.....from 1499.00
Toshiba 1000 Lap Top.....from 999.00

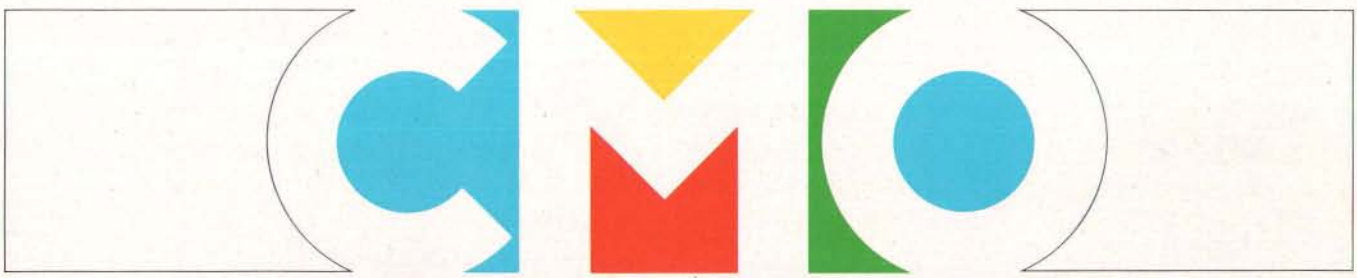
PC-TOO 512K AT-Compatible $999
(Monitor Optional)

MULTIFUNCTION CARDS

AST
Six Pak Plus PC/XT.....129.00
Hercules
Color Card.....159.00
Graphics Card Plus.....209.00
Fifth Generation
Logical Connection 256K.....299.00
Quadram
Silver Quadboard.....119.00
Video 7
EGA Video Deluxe.....319.00
Zuckerboard
Color Card w/Parallel.....89.99

MS/DOS SOFTWARE

Ashton-Tate
d-Base III+.....399.00
5th Generation
Fastback Utility.....89.99
IMSI
Optimouse w/Dr. Halo.....99.99
Lotus
Lotus 1-2-3.....329.00
MicroPro
Professional 4.0 w/GL Demo.....239.00
Microstuf
Crosstalk XVI.....89.99
P.F.S.
First Choice (Premium).....119.00
Word Perfect Corp.
Word Perfect 4.2.....209.00



COMPUTER MAIL ORDER

.....When you want to talk price.

DRIVES

Atari
AA314 DS/DD Disk (ST).....$209.00
AA354 SS/DD Disk (ST).....129.00
SHD204 20 Mb ST Hard Drive..579.00
Commodore
Amiga 1020.....189.00
Amiga 1010 3½".....219.00
1541C.....179.00
1571.....239.00
1581 3½" External.....229.00
CSI
10 mb (64-128).....1099.00
Indus
GT Disk Drive Atari XL/XE.....179.00
Microbotics
20 mb Hard Drive (Amiga).....1299.00
Racore
Jr. Expansion Chassis.....299.00
Seagate
20 mb ST-225 Hard Drive Kit....339.00
Supra
20 Meg Hard Drive (ST).....559.00
Xebec
20 mb (Amiga).....899.00

MONITORS

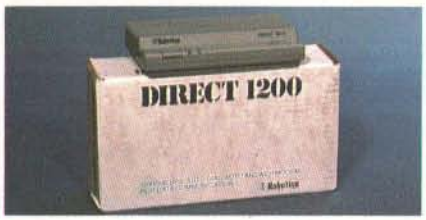
Amdek
Video 300 Amber Composite.....139.00
Commodore
Commodore 2002.....319.00
Amiga 1080 Hi-Res Color.....299.00

Magnavox 8502 Composite $179

Magnavox
8505 RGB/Composite.....199.00
NEC
12" TTL Green or Amber.....99.99
JC-1401P3A Multi-Sync.....549.00
Princeton Graphics
MAX-12 12" Amber TTL.....149.00
Taxan
Model 124 12" Amber.....119.00
Zenith
ZVM 1220/1230.....(ea.) 99.99

MODEMS

Anchor
Volksmodem 1200.....$99.99
6480 C64/128 1200 Baud.....119.00
VM520 ST520/1040 1200 Baud.129.00
Atari
XM301 300 Baud.....42.99
Best
1200 Baud External.....119.00
Commodore
Amiga 1680-1200 BPS.....169.00
CBM 1670 & C-128).....99.99
Everex
Evercom 1200 Baud Internal.....109.00
Hayes
Smartmodem 300.....129.00
Smartmodem 1200 External.....299.00
Novation
Parrot 1200.....119.00
Practical Peripherals
1200 BPS External.....159.00
Supra
MPP-1064 AD/AA C64.....69.99
1200AT 1200 Baud Atari.....139.00



U.S. Robotics Direct 1200 Ext. $109

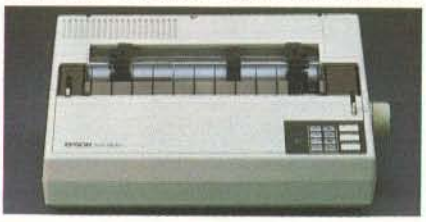
U.S. Robotics
2400 Baud Internal.....189.00

DISKETTES

Maxell
MD1-M SS/DD 5¼".....9.99
MD2-DM DS/DD 5¼".....10.99
MF1-DDM SS/DD 3½".....12.99
MF2-DDM DS/DD 3½".....21.99
Sony
MD1D SS/DD 5¼".....8.99
MD2D DS/DD 5¼".....10.99
MFD-100 SS/DD 3½".....13.99
MFD-200 DS/DD 3½".....20.99
Hewlett-Packard Calculators
28C Scientific Pro.....199.99
18C Business Consultant.....139.95
12C Slim Financial.....74.99

PRINTERS

Atari
1020 XL/XE Plotter.....$31.99
XDM121 Letter Quality.....199.00
XMM801 XL/XE Dot Matrix.....189.00
XMM804ST Dot Matrix.....179.00
Brother
M-1109 100 cps, 9 pin.....199.00
M-1409 180 cps, 9 pin.....319.00
Citizen
MSP-10 160 cps, 80-Column.....279.00
Premier 35 cps Daisywheel.....489.00
C.Itoh
315P 132 Column Prowriter.....449.00



Epson EX-800 300 cps 80 Column $369

Epson
LX-800 150 cps, Dot Matrix.....169.00
FX-86E 240 cps, 80-column.....329.00
FX286E 240 cps, 132-column....439.00
EX-1000 300 cps, 132-column...499.00
LQ-800 180 cps, 24-Wire.....459.00
Hewlett Packard
Thinkjet.....379.00
NEC
Pinwriter 2200 24 Wire.....319.00
Pinwriter 660 24 Wire.....459.00
Pinwriter 760 24 Wire.....679.00
Okidata
Okimate 20 Color Printer.....129.00
ML-182 120 cps, 80-column.....239.00
ML-192+ 200 cps, 80-column...329.00
ML-193+ 200 cps, 132-column.479.00
Panasonic
KX-1080i 120 cps, 80-column....159.00
KX-1091i 180 cps, 80-column....169.00
KX-P3131 22 cps Daisywheel....289.00
Star Micronics
NX-10 120 cps, 80-column.....159.00
NX-10C 120 cps, C64 Interface.219.00
NX-15 120 cps, 132-column.....339.00
Toshiba
P-321 SL 216 cps, 24-Pin.....539.00
P-351 II 300 cps, 24-Pin.....899.00

In the U.S.A. and in Canada

Call toll-free: 1-800-233-8950.

Outside the U.S.A. call 717-327-9575 Telex 5106017898 Fax 717-327-1217

Educational, Governmental and Corporate Organizations call toll-free 1-800-221-4283

CMO. 477 East Third Street, Dept. A110, Williamsport, PA 17701

ALL MAJOR CREDIT CARDS ACCEPTED.

POLICY: Add 3% (minimum $7.00) shipping and handling. Larger shipments may require additional charges. Personal and company checks require 3 weeks to clear. For faster delivery use your credit card or send cashier's check or bank money order. Pennsylvania residents add 6% sales tax. All prices are U.S.A. prices and are subject to change and all items are subject to availability. Defective software will be replaced with the same item only. Hardware will be replaced or repaired at our discretion within the terms and limits of the manufacturer's warranty. We cannot guarantee compatibility. All sales are final and returned shipments are subject to a restocking fee.

Circle 60 on Reader Service Card

Two for the Mac II

Providing test signals and generating waveforms for automated test equipment are two typical applications for which National Instruments' NB-AO-6 analog output board is designed. The board plugs into the Macintosh II's NuBus and features six 12-bit D/A converters.

Both unipolar and bipolar voltage outputs are available for each converter. National Instruments says each voltage output settles to within one-half least significant byte of full scale (10 volts) within 4 microseconds.

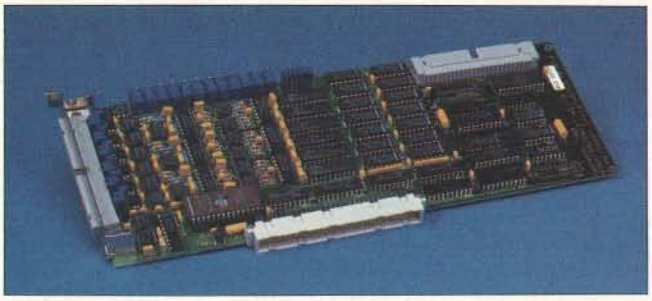
The NB-AO-6 features a high-performance real-time system integration (RTSI) bus interface that allows synchronization with processes on other NB series boards. The converter outputs can be updated by an RTSI bus signal, an external signal, or by software control.

The board allows you to supply references voltages between −10V and 10V, providing the capability for four-quadrant multiplication. Data can be written to any combination of D/As simultaneously with standard 16-bit write operations.
Price: $895.
Contact: National Instruments, 12109 Technology Blvd., Austin, TX 78727-6204, (800) 531-4742; in Texas, (800) 433-3488 or (512) 250-9119.
Inquiry 601.

Meanwhile on the Mac II front, AST Research has released an intelligent communications processor that offloads I/O processing from the Mac's 68020. The AST-ICP has a 68000 processor running at 8 MHz, 512K bytes of zero-wait-state RAM, and either two or four synchronous/asynchronous serial ports.

AST says the board provides a foundation for multiuser, multitasking environments through Unix. In addition, two of the ports can be configured to work with AppleTalk, giving developers the opportunity to create links between AppleTalk networks.

The AST-ICP plugs into the Mac II's NuBus and provides support for full NuBus arbitration. It can be configured with up to 64K bytes of EPROM.
Price: Two-port version, $949; four-port version, $999.
Contact: AST Research Inc., 2121 Alton Ave., Irvine, CA 92714, (714) 863-1333.
Inquiry 602.



National Instruments' NB-AO-6 adds six DACs to the Mac II.

386 Board for the PC

The PC-Elevator 386 is a full-length plug-in board that turns any IBM PC, XT, AT, or compatible into an 80386-based system. The board runs at 16 MHz with no wait states and includes 1 megabyte of 100-nanosecond RAM that can be expanded to a maximum of 16 megabytes using daughterboards.

According to the manufacturer, the PC-Elevator doesn't require any modifications of the host machine for installation. The 80386 processor works in tandem with the system's processor, using the original chip to handle I/O processing.
Price: $1995.
Contact: Applied Reasoning Corp., 86 Sherman St., Cambridge, MA 02140, (617) 492-0700.
Inquiry 603.

Two Megabytes for the Amiga

The latest addition to Micron Technology's line of add-on memory boards is a 2-megabyte version for all Amigas, including the 500, the 1000, and the 2000 models. If you have an Amiga 2000, you can insert the board directly into a motherboard expansion slot. If you have an Amiga 500 or 1000, you'll need an optional expansion chassis.
Price: $495; expansion chassis, $55.
Contact: Micron Technology Inc., Systems Group, 2805 East Columbia Rd., Boise, ID 83706, (800) 642-7661; in Idaho, (208) 386-3800.
Inquiry 604.

PC Multiuser System

QuickLink is a hardware/software system that turns an IBM PC, XT, AT, or compatible into a multiuser, multiprocessor MS-DOS system running under the Novell Netware operating system.

The basic hardware component of the system is the QuickLink card, a full-length expansion card that's essentially an IBM PC on a circuit board, complete with an NEC V40 processor and 768K bytes of RAM.

A standard IBM PC–compatible ASCII terminal connects to the QuickLink card using standard twisted-pair telephone wiring. Each terminal and QuickLink card becomes a complete MS-DOS workstation. Up to 51 stations can be configured on a single system.

According to its manufacturer, QuickLink is a closely coupled local area network that uses the high-speed bus of the main system to interconnect the multiple processors instead of the serial cables used in most LANs.

For those looking for growth beyond 51 stations, multiple IBM PC file servers can be interconnected. The Network Link claims that QuickLink is compatible with most off-the-shelf LAN interface cards, communication servers, and mainframe gateways. QuickLink is compatible with COM1 and COM2 for printer and modem hookup. I/O ports are user-selectable via DIP switches.
Price: $1095.
Contact: The Network Link, 3303 Harbor Blvd., Bldg. H-10, Costa Mesa, CA 92626, (714) 549-9380.
Inquiry 606.

Micro Channel Prototype Board

For those who have an uncontrollable urge to work on their own hardware for the IBM PS/2 Micro Channel bus, a company by the name of 29 Industries has developed two different PS/2 prototype boards.

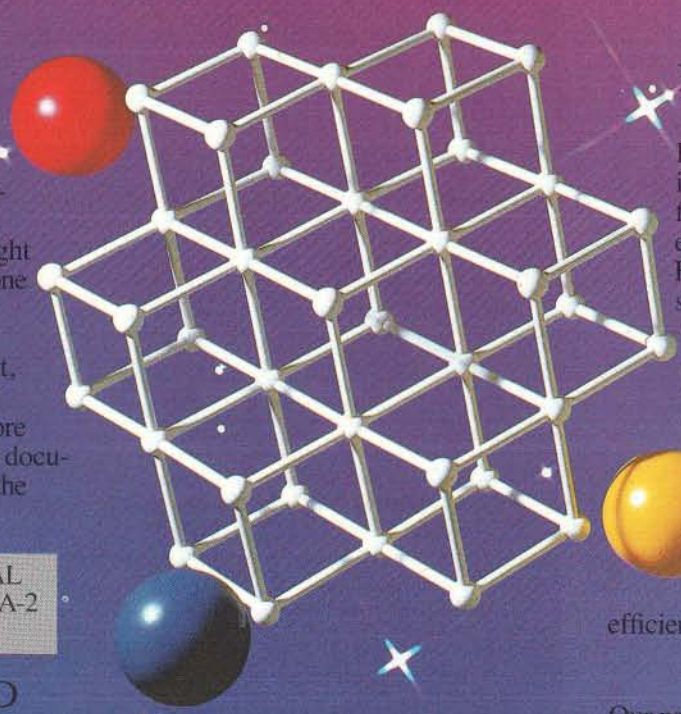
Both single-layer and four-layer boards are available. The four-layer board has separate power and ground planes, with top-row through holes of +5V and a bottom row of ground connections. Both boards have 3500 tin lead reflow holes, each with 0.035- inch on 0.1-inch centers. Bus connectors on both boards are gold-plated.
Price: Single-layer, $39.95; four-layer, $59.95.
Contact: 29 Industries Inc., 6190 North Federal Highway, Boca Raton, FL 33431, (305) 994-9229.
Inquiry 605.

continued

SOFTWARE ENGINEERING COMES OF AGE.

ANNOUNCING LOGITECH MODULA-2 VERSION 3.0

Modula-2 is the language of choice for modern software engineering, and LOGITECH Modula-2 is the most powerful implementation available for the PC. The right language and the right tools have come together in one superior product. Whether you're working on a small program or a complex project, with LOGITECH Modula-2 Version 3.0 you can write more reliable, maintainable, better documented code in a fraction of the time at a fraction of the cost.



FREE TURBO PASCAL TO LOGITECH MODULA-2 TRANSLATOR

NEW, IMPROVED COMPILER

Faster and more flexible. Now its DOS linker compatible object files (.OBJ) can be linked with existing libraries in C, PASCAL, FORTRAN and ASSEMBLER — so you can build on previous development and put the power of LOGITECH Modula-2 to work for you right now. Fully supports Wirth's latest language definition, including LONGINT and LONGSET, which provides large set support including SET of CHAR. Provides optimization for tighter, more efficient code generation.

NEW, IMPROVED DEBUGGERS

Time gained with a fast compiler can be lost at debug time without the right debugging tools. With the powerful Logitech Modula-2 Debuggers you can debug your code *fast*, and dramatically improve your overall project throughput. The Post Mortem Debugger analyzes the status of a program after it has terminated while the dynamic, Run Time Debugger monitors the execution of a program with user-defined break points. With their new, mouse based, multiple-window user interface these powerful debugging tools are a pleasure to use.

NEW, INTELLIGENT LINKER

Links only those routines from a particular module that you need, so you eliminate unreferenced routines and produce smaller, more compact executable files.

NEW EDITOR

Our new, mouse based editor is fully integrated, easy to learn, fast and easy to use, and very customizable. Its multiple, overlapping windows and color support make it easy to manage parts of one file or several files on the screen at one time. You'll love using it — with or without a mouse.

Call for information about our VAX/VMS version, Site License, University Discounts, Dealer & Distributor pricing.

To place an order call toll-free:

800-231-7717

In California:

800-552-8885

☐ LOGITECH Modula-2 V. 3.0 Compiler Pack — **$99**
Compiler in overlay and fully linked form, Linkable Library, Post Mortem Debugger, Point Editor

☐ LOGITECH Modula-2 V. 3.0 Toolkit — **$169**
Library sources, Linker, Run Time Debugger, MAKE, Decoder, Version, XRef, Formatter

☐ LOGITECH Modula-2 V. 3.0 Development System — **$249**
Compiler Pack plus Toolkit

☐ Turbo Pascal to Modula-2 Translator — **FREE**
With Compiler Pack or Development System

☐ Window Package — **$49**
Build true windowing into your Modula-2 code.

☐ Upgrade Package
Call LOGITECH for information or to receive an order form.

Add $6.50 for shipping and handling. California residents add applicable sales tax. Prices valid in U.S. only. Total Enclosed $ _____

☐ VISA ☐ MasterCard ☐ Check Enclosed

Card Number _____ Expiration Date _____

Signature _____

Name _____

Address _____

City _____ State _____

Zip _____ Phone _____

LOGITECH

LOGITECH, Inc.
6505 Kaiser Drive, Fremont, CA 94555
Tel: 415-795-8500

In Europe: LOGITECH, Switzerland
Tel: 41-21-87-9656 Telex 458 217 Tech Ch

In the United Kingdom: LOGITECH, U.K.
Tel: 44908-368071 Fax: 44908-71751

Turbo Pascal is a registered trademark of Borland International. VAX and VMS are registered trademarks of Digital Equipment Corp.

Circle 154 on Reader Service Card (Dealers: 155)

Pascal for the Apple IIGS

ORCA/Pascal, an implementation of ISO standard Pascal, offers over 60 built-in procedures and functions. Extensions include UCSD-style strings, bit-manipulation operators, and extensions for systems and scientific programming. You can run ORCA/Pascal in stand-alone mode or install it under the Apple Programmer's Workshop or ORCA/M for the Apple IIGS shells. Access to the Apple IIGS Toolkit is provided, and the program features directives to control large or small memory models.

According to Byte Works, ORCA/Pascal runs the Sieve of Eratosthenes benchmark in 5.4 seconds on the Apple IIGS.

Price: $125.

Contact: Byte Works Inc., 4700 Irving Blvd. NW, Suite 207, Albuquerque, NM 87114, (505) 898-8183.

Inquiry 607.

Pascal Source Tool

TurboRef 4.0, a $49.95 cross-referencing and listing utility, assists in locating variable names and mapping logical structures in Pascal source code.

The lister encloses control blocks in boxes and indicates the current procedure name for each source line and the source file for each line. You can highlight comments in bold, as well as underline reserved words.

The cross-reference utility lists the line number for each use of variables and constants, and it lists the type of use for each reference. You can upshift lowercase names or reference them separately. You can also process a list of files for separate or combined cross-references; with multiple source files, you can list the filename with each reference.

Version 4.0 features separate printer-configuration files, enabling you to use virtually any printer, Gracon reports. The addition of block reads and writes has increased the speed of execution with this new version.

TurboRef 4.0 runs on IBM PCs with 128K bytes of RAM, MS-DOS 2.0 or higher, and a Pascal compiler from Borland, Microsoft, or Software Building Blocks.

Price: $49.95.

Contact: Gracon Services Inc., P.O. Box 340, Haslett, MI 48840-0340, (517) 349-4900.

Inquiry 608.

COBOL Productivity Tool

ProCode the Development Tool (PCDT) is a COBOL programming tool that creates debugged ANSI COBOL 74 source code and runs it through a compiler. PCDT lets you generate COBOL program shells and data-definition logic at a rate of 3000 lines per minute, ProCode reports. You can create custom screens and online help for each data-definition field.

PCDT runs on MS-DOS– or PC-DOS–based systems with at least 256K bytes of RAM. A hard disk drive is recommended, but not necessary to run the program.

Price: $995.

Contact: ProCode, 859-44 State Rd. 436, Casselberry, FL 32707, (305) 699-6799.

Inquiry 609.

80386 BASIC Compiler

True BASIC's 386 BASIC compiler includes an implementation of Phar Lap's Run386. Features and syntax are identical to version 2.0 of True BASIC, but with the 80386 version you can create megabyte-long strings and perform matrix algebra with arrays that completely fill memory, the company reports. The 80386 version will also support the 80387 microprocessor.

Price: Under $500.

Contact: True BASIC Inc., 39 South Main St., Hanover, NH 03755, (603) 643-3882.

Inquiry 610.

Programming on the Commodore 64 and 128

Designed to facilitate application development for GEOS, geoProgrammer offers an assembler, linker, and symbolic debugger. The assembler reads source text from documents created with geoWrite, a WYSIWYG word processor that enables you to place comments in bold or italics or paste a picture from geoPaint. The graphics appear as pictures in the listing instead of just numbers. The assembler supports standard 6502 assembly language mnemonics and addressing modes, and you can design over 1000 labels for each assembly module.

Expressions can include a combination of arithmetic and logical operators. A macro facility supports nested invocation and multiple arguments. Pseudo-operators are incorporated into geoAssembler for conditional assembly, memory segment–type definition, and space allocation.

The linker accepts link structure from geoWrite documents and reads relocatable object modules produced by geoAssembler. It supports GEOS SEQ-type and VLIR applications, resolves cross-references, and evaluates unresolved arithmetic and logical expressions passed from the assembler. Error messages are placed in geoWrite documents, and executable files are created.

The debugger transforms the RAM Expansion Unit into a monitor so that you can debug applications with the maximum available memory. It also features memory examination and modification commands, including symbolic line disassembly and a line assembler for patching codes. Results are printed into an overlay text window.

Price: $69.95.

Contact: Berkeley Softworks, 2150 Shattuck Ave., Berkeley, CA 94704, (415) 644-0883.

Inquiry 611.

Prolog Knowledge Base Manager

BridgeWare is a stand-alone application that lets you create Prolog databases that you incorporate as knowledge bases into expert systems. It works with ASCII files, or it can access data from other programs or languages. It can also combine information from several applications into a single knowledge base.

BridgeWare's Schema editor lets you create and maintain your knowledge base with full-screen and visual editing of files and terms, management of linked files, formats for parsing ASCII text files, and a print function.

The program is compatible with Edinburgh, Turbo, and ExperProlog. Example programs and data are included for languages and programs including BASIC, C, Pascal, dBASE II and III, Lotus 1-2-3, and Symphony.

To run BridgeWare you need an IBM PC, AT, XT, or compatible with MS-DOS or PC-DOS 2.1 or higher.

Price: $69.95.

Contact: MicroBase Software Systems Inc., Medford Office Center, Old Marlton Pike, Medford, NJ 08055, (609) 654-7394.

Inquiry 612.

continued

Introducing Logitech's Publishing Solution

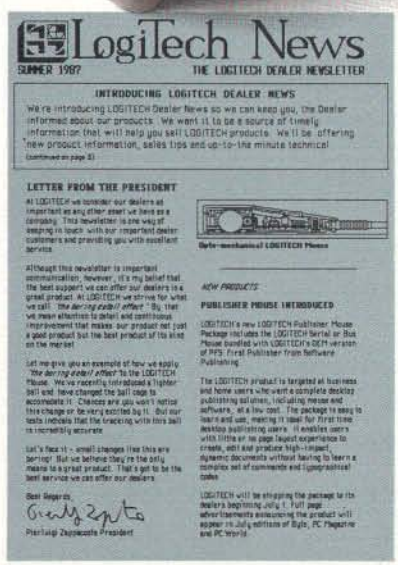
LOGITECH MOUSE $179
with Publisher Software

Our Mouse and Publisher Software is the complete solution for people who want to produce great looking, attention getting documents without having to master a lot of complex commands and typographical jargon. It's easy to learn, fast to use, and it gets you the results you need right now.

Page Layout Made Easy
You don't have to be a graphic designer to get professional quality results. Create and edit text right on the page. We offer design templates, automatic layout in 1-4 columns, automatic flow of text around graphics, and vertical and horizontal rulers to guide you.

Typography Made Easy
Select from over 61 fonts representing 14 typefaces, in sizes suitable for headlines, subheads and text. We provide optimal line spacing automatically. You adjust for special effects.

Graphics Made Easy
Use our ClipArt or create your own using LOGIPAINT, PC Paintbrush or MS Windows Paint software. You can shrink or expand your graphic images to fit. You can also modify, rotate or copy them.


LogiTech News
SUMMER 1987 THE LOGITECH DEALER NEWSLETTER
INTRODUCING LOGITECH DEALER NEWS
We're introducing LOGITECH Dealer News so we can keep you, the Dealer informed about our products. We want it to be a source of timely information that will help you sell LOGITECH products. We'll be offering new product information, sales tips and up-to-the minute technical
LETTER FROM THE PRESIDENT
NEW PRODUCTS
PUBLISHER MOUSE INTRODUCED

Produced on a dot matrix printer. Laser printer support also included.

30 Day Money-Back Guarantee
3 Year Warranty

To place a credit card order call our special toll-free number:
800-231-7717
Call toll-free in California:
800-552-8885

YES! I want to produce great looking documents now!

LOGITECH Publisher Package **$179**
☐ w. Serial Mouse *and Plus Software*
☐ w. Bus Mouse *and Plus Software*
Add $6.50 for shipping and handling. California residents add applicable sales tax. Prices valid in U.S. only.
Total Enclosed $_____
☐ VISA ☐ MasterCard ☐ Check Enclosed

Card Number Expiration Date
Signature
Name
Address
City State
Zip Phone

DEALER INQUIRIES WELCOME

LOGITECH

LOGITECH, Inc.
805 Veterans Blvd., Redwood City, CA 94063
Tel: 415-365-9852
In Europe:
LOGITECH SA, Switzerland
Tel: 41-21-879656 • Telex 458 217 Tech Ch
In Italy:
Algol-Logitech Spa 39-2-215-5622

Circle 156 on Reader Service Card (Dealers: 157)

Plot and Display Stresses with CPLOT

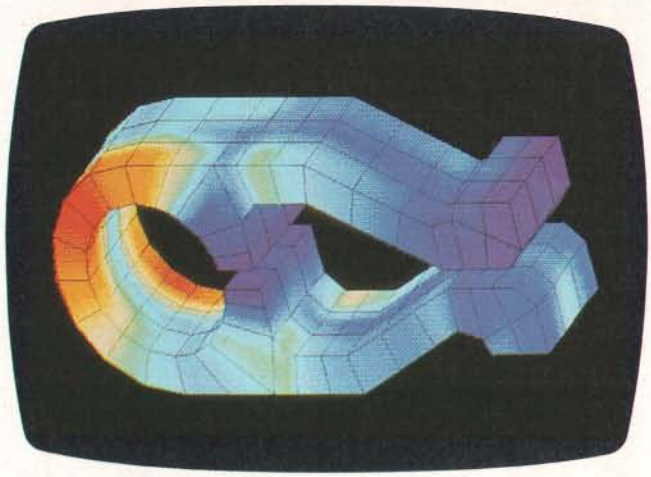
Part of Algor's Supersap finite-element stress, dynamic, and heat-transfer modeling and analysis system, CPLOT enables you to plot and display stress, displacement, temperature, and heat flux.

The program uses the shading technique of dithering to display stress, temperature, and other contours. The technique uses patterns of different-color pixels to simulate intermediate colors on a computer screen. Dithering enables you to see 33 shades of color with a CGA (with only 4-color capability). With an EGA, dithering can turn seven colors into 97, with 15 shades between each base color.

With CPLOT you can see a graphic display of the stress or thermal state and yield criteria stresses, such as Von Mises or Tresca stresses. You can view plots of stress-contour lines, iso-stress lines, shaded stress contours, superimposed stress-contour lines, and shaded contours.

The program uses colors to represent degrees of stress, and you can change the color mapping to suit your needs.

CPLOT runs on IBM PCs and compatibles and requires MS-DOS or PC-DOS 2.0 or higher.
Price: $995.
Contact: Algor Interactive Systems, Essex House, Essex Square, Pittsburgh, PA 15206, (412) 661-2100.
Inquiry 613.



CPLOT displays stress, displacement, and temperature.

A Calculator for Your PC

The Lascaux1000 is based on a model of a pocket calculator. It uses dimensional analysis, which is the recognition of physical quantities rather than just numbers. You can enter the units of measurements you want calculated, along with numbers, and the calculator performs the conversions. It recognizes over 150 units of measurement and has a table of over 200 constants used in physics, chemistry, and engineering. You can also expand and customize its internal tables.

What you see on-screen looks like a calculator, with the paper tape scrolling above it. You can view the full length of paper tape on screen or output it to your printer.

The Lascaux1000 runs on IBM PCs and compatibles with at least 320K bytes of RAM.
Price: $59.
Contact: Lascaux Graphics, 3220 Steuben Ave., Bronx, NY 10467, (212) 654-7429.
Inquiry 614.

Science Study through Software

Students can study biology and physics on their computers with software from Mindscape and Brøderbund.

That's Life: Explorations and Simulations in Biology lets students in grades seven through 10 explore human physiology, field ecology, applied genetics, and comparative zoology. Students can participate in adventure programs or simulations. The adventure programs include Human Body Exploration and Comparative Physiology Exploration, and the simulations include Applied Genetics Simulation and Field Ecology Simulation. Students participate in the research process, developing their scientific research and deductive-reasoning skills.

Mindscape reports that the program correlates to 15 life science and biology texts, a list of which is provided.

That's Life runs on Apple IIs with at least 64K bytes of RAM.
Price: $175.
Contact: Mindscape Inc., 3444 Dundee Rd., Northbrook, IL 60062, (312) 480-7667.
Inquiry 615.

Brøderbund's Physics is another interactive educational program, and it lets students experiment with manipulating vectors, interpreting graphs, and answering over 300 problems. They can also study orbital motion by experimenting with velocity and position. The program provides hints, further explanations, and answers to problems when necessary.

Physics runs on 512K-byte Macintoshes with external disk drives, as well as on the 512E Mac, Mac Plus, and SE.
Price: $99.95.
Contact: Brøderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903-2101, (415) 479-1700.
Inquiry 616.

Math-Processing Software

The Professional Wheel Calculation Processor is a math program that lets you perform many different kinds of mathematical and scientific calculations in an interactive environment. It runs on the IBM PC, XT, AT, or compatibles with PC-DOS or MS-DOS 2.0 or higher, one floppy disk drive, and 384K bytes of RAM.

The program includes a full-screen editor with built-in mathematical functions and a library that lets you create your own library of formulas and functions that you can call readily for later use. Functions and other calculations can be documented for future reference. You can analyze functions by calculating individual or incremental values, derivatives, or integrals, as well as by plotting.

The program can also calculate statistical probabilities, correlations, and frequency analysis. In addition, it performs conversions of commonly used units of measure for length, area, volume, weight, and temperature.

Certain features are available as pop-up utilities. These include the unit-conversion utility and two calculation processors that are capable of repetitive calculations and can call user-defined functions and constants.
Price: $158.95 until October 30; $199.95 thereafter.
Contact: Dalin Inc. Applications Software, 16421 Clymer St., Granada, CA 91344, (818) 360-7058.
Inquiry 617.

continued

Get Your Hands On More Solutions.

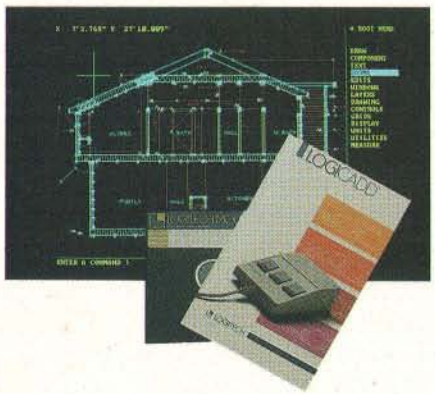
LOGITECH MOUSE $99
with Plus Software $119

PC MAGAZINE EDITOR'S CHOICE

Purchase our best selling LOGITECH Serial or Bus Mouse and Plus Package with CADD, Paint and Publisher software at very affordable prices. Each package is a complete solution that gets you the results you need right now.

CADD Solution $189

Our Mouse, Plus Software and LOGICADD (Generic CADD 3.0 plus DotPlot). Everything you need to turn your PC into a full featured CADD workstation. It's the complete solution for dimensioned line drawing and CADD.



Paint Solution $149

Our Mouse, Plus Software and LOGIPAINT (PC Paintbrush). With 11 type fonts and a 16 color palette, it's the paint set that's used by professional and beginning users alike. LOGIPAINT files move easily into both LOGICADD and Publisher documents.

Publishing Solution $179

Our Mouse, Plus Software and PUBLISHER Software (PFS: First Publisher). It's the complete package that makes it easy to produce high-impact, professional looking documents.

To place a credit card order call our special toll-free number:

800-231-7717

Call toll-free in California:

800-552-8885

YES! I want the LOGITECH Mouse solution!

LOGICADD Package **$189**
- ☐ w. Serial Mouse *and Plus Software*
- ☐ w. Bus Mouse *and Plus Software*

LOGIPAINT Package **$149**
- ☐ w. Serial Mouse *and Plus Software*
- ☐ w. Bus Mouse *and Plus Software*

PUBLISHER Package **$179**
- ☐ w. Serial Mouse *and Plus Software*
- ☐ w. Bus Mouse *and Plus Software*

Add $6.50 for shipping and handling. California residents add applicable sales tax. Prices valid in U.S. only.

Total Enclosed $_____

☐ VISA ☐ MasterCard ☐ Check Enclosed

Card Number _____ Expiration Date _____

Signature _____

Name _____

Address _____

City _____ State _____

Zip _____ Phone _____

LOGITECH

LOGITECH, Inc.
805 Veterans Blvd. ,Redwood City, CA 94063
Tel: 415-365-9852

In Europe:
LOGITECH SA, Switzerland
Tel: 41-21-879656 • Telex 458 217 Tech Ch

In Italy:
Algol-Logitech Spa 39-2-215-5622

Generic CADD is a trademark of Generic Software. PC Paintbrush is a trademark of ZSoft Corp. PFS: First Publisher is a trademark of Software Publishing Corp.

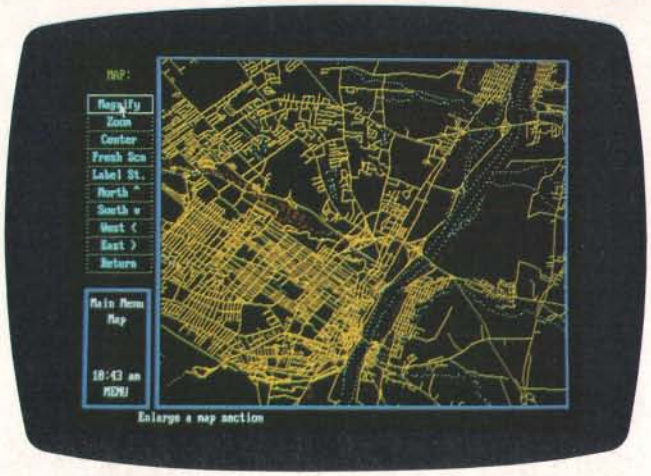
Circle 158 on Reader Service Card (Dealers: 159)

Map Information Display and Analysis System

With MIDAS you can locate street addresses and display a map from raw data or from a database. The program supplies maps of over 300 U.S. metropolitan areas, including names of every street, river, and bridge, as well as address number ranges for every block and side of a street. You can create your own map using the keyboard, a mouse, or a digitizer.

MIDAS can also show boundary designations, such as city, town, and county borders, or you can designate your own. You can use the boundary features to search for data points within a border, determine what boundaries a given point lies within, or overlay different boundaries. A zoom-in/zoom-out function is also available.

The program runs on IBM PCs, XTs, ATs, and compatibles with 640K bytes of RAM, MS-DOS or PC-DOS 2.0 or higher, and a hard disk drive. A color graphics monitor is recommended, along with a full-color plotter; however, MIDAS works with monochrome adapters and supports most printers and plotters. MapInfo also recommends dBASE III Plus or a similar database program.
Price: $750; metropolitan area maps cost between $300 and $2000.
Contact: MapInfo, Hendrick Hudson Building, 200 Broadway, Troy, NY 12180, (518) 274-8673.
Inquiry 618.



MIDAS displays geographical data in black and white or color.

Text Editor for the Amiga

CygnusEd combines word-processing and programming features, including auto-indent and macro keys. Designed to be used with a mouse or keyboard, it is written in assembly language. To run the program, you need an Amiga 500, 1000, or 2000 with at least 512K bytes of RAM.

With CygnusEd you can edit multiple files simultaneously and see multiple views of the same files, use intuitive commands and macros, run from the CLI or Workbench, set margins, and use word-wrap functions.
Price: $30.
Contact: CygnusSoft Software, P.O. Box 363, 1215 Davie St., Vancouver, B.C., V6E 1N4 Canada, (604) 688-1085.
Inquiry 619.

WordPerfect for the Amiga

WordPerfect for the Amiga supports multitasking, features pull-down menus, and lets you use the mouse or the keyboard. In addition, the Amiga's files are compatible with WordPerfect 4.1 for the IBM PC.

File-management features include a Look option and the ability to perform common file operations without exiting the program. You can rename, delete, print, or copy files. The Look option lets you preview the contents of a document, and a Search option displays only those files that contain a given word or phrase.

Other features of the program include footnotes and endnotes, macros, merging, paragraph and outline numbering, and table of contents and index generation.

A spelling checker with a 115,000-word dictionary includes a phonetic and word-template lookup. You can also create your own dictionaries, or import those created with WordPerfect on the IBM PC.

The thesaurus lets you display synonyms and antonyms for two words at the same time.

The program supports interlace mode but does not offer bit-mapped fonts.
Price: $395.
Contact: WordPerfect Corp., 288 West Center St., Orem, UT 84057, (801) 225-5000.
Inquiry 620.

VP-Planner Plus

Paperback Software's new version of VP-Planner has a word processor and graphics tools. With the program, you can also set up a multidimensional database via prompts.

VP-Planner Plus is compatible with Lotus 1-2-3 version 2.0, but it features a revised interface that is not like Lotus 1-2-3's.

The program runs on IBM PCs and compatibles with at least 256K bytes of RAM or 320K bytes when using multidimensional files. A CGA, EGA, or Hercules adapter is also required.
Price: $174.95.
Contact: Paperback Software, 2830 Ninth St., Berkeley, CA 94710, (415) 644-2116.
Inquiry 621.

Flying with Yeager

Chuck Yeager's Advanced Flight Simulator offers you the chance to test and fly in formation with real and experimental aircraft at Mach speeds, according to Electronic Arts.

Three levels of instruction are offered. The first teaches basics, such as take-offs and landings; the second covers more advanced maneuvers, like aileron rolls and hammerhead stalls; and the third teaches acrobatic stunts. The latter prepares you to use the Formation Flying feature, in which you follow Yeager through obstacle courses and three-dimensional terrain. A flight recorder lets you create and store your stunt flying patterns.

A Test Pilot option offers a selection of 14 aircraft to check out, using actual test-pilot aircraft-evaluation charts.

The flight simulator runs on IBM PCs, XTs, ATs, and compatibles with MS-DOS or PC-DOS 2.0 or higher. The program supports CGA, EGA, and compatible graphics adapters. Electronic Arts reports that a Commodore 64/128 version is in the works.
Price: $39.95.
Contact: Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404, (415) 571-7171.
Inquiry 622.

EVENTS

October 1987

Commodore Show, Anaheim, CA. R.K. Productions, P.O. Box 18906, San Jose, CA 95158, (800) 722-7927; in California, (800) 252-7927. *October 3–4*

Buscon/87-East, Marlborough, MA. Edward E. Grazda, Director of Education, 17100 Norwalk Blvd., Suite 116, Cerritos, CA 90701-2750, (213) 402-1610. *October 5–7*

Computer Security Technology and Techniques, Berkeley, CA. Continuing Education in Engineering, University of California Extension, 2223 Fulton St., Berkeley, CA 94720, (415) 642-4151. *October 5–7*

1987 Nebraska Videodisc Symposium—Education: Discoveries and Decisions, Lincoln, NE. Videodisc Design/Production Group, P.O. Box 83111, Lincoln, NE 68501-3111, (402) 472-3611. *October 5–8*

Twelfth Annual DSSD User's Conference—Information Power: The Strategic Imperative, Kansas City, MO. Georganna Carson, Ken Orr & Associates Inc., 1725 Gage Blvd., Topeka, KS 66604-3379, (800) 562-8000; in Kansas, (913) 273-0653. *October 6–8*

Calgary Computer/Office Technology Show, Calgary, Alberta, Canada. Gary Gow, Calgary Computer/Office Technology Show, 1015 Centre St. N, Suite 200, Calgary, Alberta, Canada T2E 2P8, (403) 276-7881. *October 7–8*

Seventh Annual Educational Computer Fair: Computers—Tools Reshaping Education, Cleveland, OH. Alice Fredman, Educational Computer Consortium of Ohio, 1123 S.O.M. Center Rd., Cleveland, OH 44124, (216) 461-0800. *October 8–9*

Seventh Annual Symposium on Small Computers in the Arts, Philadelphia, PA. Richard Moberg, 338 South Quince St., Philadelphia, PA 19107, (215) 834-1511. *October 8–11*

Northeast Atari Computer Fair, Worcester, MA. Alan Glick, Boston Computer Society, One Center Plaza, Boston, MA 02108, (617) 296-8286. *October 9–11*

AmiEXPO, the Amiga Event, New York, NY. AmiEXPO Headquarters, 211 East 43rd St., Suite 301, New York, NY 10017, (800) 322-6442; in New York, (212) 867-4663. *October 10–12*

Computer Graphics of Fractals: Algorithms from the Frontiers of Research, Santa Clara, CA. Sally Thomas, University of California Extension, Carriage House, Santa Cruz, CA 95064, (408) 429-4985. *October 12–13*

Second Annual PC Expo, Chicago, IL. Jim Mion, 333 Sylvan Ave., Englewood Cliffs, NJ 07632, (800) 922-0324; in New Jersey, (201) 569-8542. *October 13–15*

Voice Information Services Industry: Progress and Prospects, Washington, DC. Information Industry Association, 555 New Jersey Ave. NW, Suite 800, Washington, DC 20001, (202) 639-8262. *October 14–15*

Computer Technology/Special Education/Rehabilitation, Northridge, CA. Dr. Harry J. Murphy, California State University–Northridge, Office of Disabled Student Services, 18111 Nordhoff St., Northridge, CA 91330, (818) 885-2578. *October 15–17*

Northeast Computer Faire, Boston, MA. The Interface Group Inc., 300 First Ave., Needham, MA 02194, (617) 449-6600. *October 15–17*

1987 International Symposium on Laboratory Robotics, Boston, MA. International Symposium on Laboratory Robotics, Zymark Corp., Zymark Center, Hopkinton, MA 01748-9990, (617) 435-9501. *October 18–21*

Interex North American Conference of Hewlett-Packard Technical Computer Users, San Jose, CA. Interex Conference Department, 680 Almanor Ave., Sunnyvale, CA 94086-3513, (408) 738-4848. *October 18–22*

Technetron '87: Integration—Meeting the Challenge, Boston, MA. International Society of Wang Users, Wang Laboratories Inc., Mail Stop 019-350, One Industrial Ave., Lowell, MA 01851, (617) 967-4322. *October 18–22*

Database Expo, Anaheim, CA. Engineering Information Inc., 345 East 47th St., New York, NY 10017, (800) 221-1044; in New York, (212) 705-7635. *October 19*

Conference on Data and Knowledge Systems for Manufacturing and Engineering, East Hartford, CT. Fred Maryanski, CSE Dept., U-155, Storrs, CT 06268, (203) 486–2584. *October 19–20*

APICS Thirtieth Annual International Conference and Technical Exhibit, St. Louis, MO. APICS Meetings Department, 500 West Annandale Rd., Falls Church, VA 22046-4274, (800) 368-3402; in Virginia, (703) 237-8344. *October 19–23*

Third Expert Systems in Government Conference, Washington, DC. Peter Bonasso, AI Director, Mitre Washington AI Center, 7725 Colshire Blvd., MS W952, McLean, VA 22102, (703) 883-6908. *October 19–23*

International Test and Transducer Instrumentation Exhibition and Conference, London, U.K. Trident International Exhibitions Ltd., 21 Plymouth Rd., Tavistock, Devon PL19 8AU, U.K., 822-4671. *October 20–22*

Computer Technology in Special Education and Rehabilitation, Minneapolis, MN. Closing the Gap Inc., P.O. Box 68, Henderson, MN 56044, (612) 248-3294. *October 20–24*

Conference on Computers and Law, Santa Monica, CA. Michael M. Krieger, P.O. Box 24619, Los Angeles, CA 90024, (213) 393-9910. *October 21–23*

Sixth National Print Quality Seminar, Bedford, MA. Frank Stefansson, Datek Information Services Inc., P.O. Box 68, Newtonville, MA 02160, (617) 893-9130. *October 25–27*

EDUCOM '87, Los Angeles, CA. Carol Parysz, EDUCOM, P.O. Box 364, Princeton, NJ 08540, (609) 734-1888. *October 27–30*

Applied Imagery Pattern Recognition, Washington, DC. Jane Harmon, 403 Argus Place, Sterling, VA 22170, (703) 351-2708. *October 28–30* ■

Motorola M68000

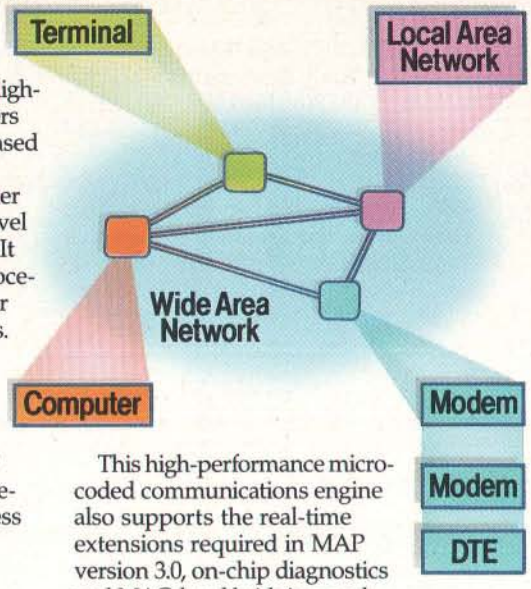
Your high-performance systems require a wide range of microprocessor and peripheral support. The versatile M68000 Family serves those needs with product that's well documented, easy to use, cost effective, easy to get and as varied as your applications.

Versatile solutions for the need to communicate data.

Motorola has developed a family of high-performance communications controllers called Serial Processing Units (SPUs) based on a modular design concept.

The MC68605 X.25 Protocol Controller (XPC) independently generates link-level commands for X.25 and X.75 networks. It expertly terminates the Link Access Procedure Balanced (LAPB) at the full 1.544 or 2.048 data rates provided by T1 facilities. It has passed rigorous Defense Data Network certification tests, and its global acceptance is suggested by use on packet networks all over Europe.

The MC68824 Token Bus Controller (TBC) is the only single-chip VLSI implementation of the IEEE 802.4 Media Access Control (MAC) sublayer defined in the Manufacturing Automation Protocol (MAP) specification.



This high-performance microcoded communications engine also supports the real-time extensions required in MAP version 3.0, on-chip diagnostics and MAC-level bridging, and implements the recommended standard MAC-to-physical serial interface.

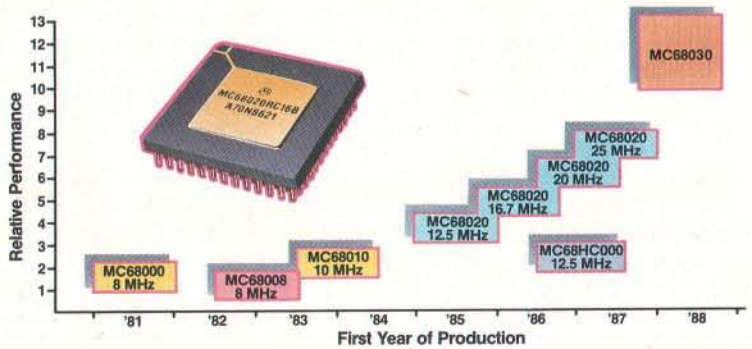
The MC68184 Broadband Interface Controller is, with RF circuitry, the broadband modem required for each node of a broadband MAP network.

In addition to the SPUs, M68000 communications peripherals include the MC68661 Universal Synchronous Communications Controller, the MC68652 Multi-Protocol Communications Controller, several DMA circuits and a variety of miscellaneous single- and multifunction devices. A

The highest-performance 8/16/32-bit MPUs smooth the migration path for your products.

Common internal 32-bit architecture. Object-code software compatibility. Just two of the reasons M68000 Family microprocessors from the 8-bit MC68008 to the 32-bit industry standard MC68020 give your products both the highest performance and the smoothest migration path.

Operating speeds range from 8 MHz for low-cost applications to the industry's fastest general purpose MPUs at 25 MHz.



And, products based on M68000 Family MPUs are the standard for UNIX® operating systems, CAD/CAM workstations, next-generation office automation, multi-user/multi-tasking departmental computers, color graphics as well as for real-time factory automation.

M68000 MPUs are also preferred engines for high-performance artificial intelligence with large linear addressing requirements.

Large, flexible 32-bit register set, large linear address space, powerful yet simple instruction set and flexible addressing modes all add up to the competitive advantage for your M68000 MPU-based product. B

UNIX is a registered trademark of AT&T.
HDS-300 is a trademark of Motorola Inc.

Emulate in real time, debug in record time, with the most powerful M68000 Family development system.

Motorola's HDS-300™ hardware/software development station can give you an important edge in slashing development time and moving your product to market when you design in one of the industry's leading M68000 family MPUs.

It simplifies and speeds up debugging and testing of your MPU hardware and software, and in the appropriate configuration can also provide source-level debug for even greater development-time reduction.

Labor-saving features include real-time no wait-state emulation to 25 MHz, system performance analysis and "C" language source-level debugging. Cost efficiency is achieved with a modular approach that permits operation with any of the available emulator modules, including MC68020, MC68010, MC68000 and MC68008.

There are so many more reasons why the HDS-300 development station is the ultimate emulation and analysis tool for systems based on MC68000 Family processors. Discover them. C

Peripherals Today

Create three different high-performance systems with our $98 design kit.

It's worth a lot more, of course, but we put the irresistibly low $98 price on our MC68000KIT so you'll never forgive yourself if you don't experience the flexibility, versatility and performance of the M68000 Family.

The design kit has just what you need to create three M68000-based systems.

Three MPUs include the MC68000 16-bit general-purpose standard, the high-performance 16-bit virtual memory MC68010 and the cost-effective 8-bit MC68008 with the 32-bit internal architecture of the MC68000.

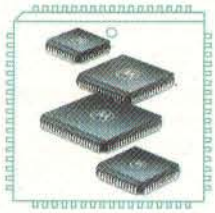
Six flexible family peripherals are included so you can design for your specific applications.

The MC68440 with dual independent DMA channels provides DMA control. System timing and parallel I/O requirements are handled by the MC68230. The MC68901 is a multifunction circuit with a single-channel UART for data communications, in addition to an 8-source interrupt controller, four 8-bit timers and eight parallel I/O lines.

Three different serial communications devices, MC68681, MC68661 and MC68652, complete the parts complement, and the kit also contains the documentation you'll want for converting these high-performance M68000 Family devices into superior systems of your own design.

The MC68000KIT is available only through authorized Motorola distributors. Contact your Motorola distributor to take advantage of this great $98 value. **D**

M68000 Family now offers surface-mount packaging.



As customers develop the ability to utilize surface-mount packages, Motorola is putting the M68000 Family in "J"-leaded, Plastic Leaded Chip Carriers. Several MPUs and over a half-dozen varied peripherals are already available now or later this year. The MC68000, MC68HC000 (HCMOS) and MC68010 are available now in the 68-lead package. The MC68008 is available now in the 52-lead version.

PLCC-packaged family peripherals include the MC68824 and MC68605 SPUs (84-lead), MC68440 and MC68442 DMA devices (68-lead), MC68681/2681 DUART (44-lead), MC68230 Programmable Interface/Timer (52-lead) and the MC68901 Multifunction circuit (52-lead). And this is only the beginning. **E**

Heralded Motorola M68000 Family training courses now available on audio cassettes.

Two Motorola-developed training courses for the MC68000 and MC68020 are now available on audio cassettes. Both of these low-cost courses also include course notes and appropriate technical literature.

Course MTTA1 is an overview of the MC68000 microprocessor: pins and bus operation, addressing modes, instruction set and exception processing including interrupts. Course completion offers you basic familiarity with the MC68000.

Course MTTA2 is an introduction to the MC68020: internal architecture, programming model, pins and bus operation, addressing modes, instruction set and exception processing.

MTTA1 is $60. MTTA2 is $95. The price for both courses together is $140.

A new course on the MC68030, MTTA3, is available in mid-September at $95. **F**

Literature Packs supply M68000 Family device and application information.

M68000 Family product literature has been assembled into three special, distinct assortments for differing interests. They include brochures, technical summaries and data sheets, benchmark reports, application notes, technical article reprints and other useful pieces.

The M68KPAK is the M68000 Family overview, from chips and software to board- and system-level products.

The M32BITPAK focuses on our top-o'-the-industry 32-bit products, featuring the MC68020, of course.

The M68KCOMPAK is oriented to the extensive M68000 Family communications capabilities. **G**

One-on-one design-in help.

Get engineer-to-engineer insight on designing-in the M68000 Family.

1-800-521-6274

Call toll-free any weekday, 8:00 a.m. to 4:30 p.m., MST. If the call can't cover your needs, we'll have our local applications engineer contact you.

We're on your design-in team.

MOTOROLA

Please send me the following information on the M68000 Family.

- A ☐ M68000 Family Communications Capability
- B ☐ M68000 Family High-Performance MPUs
- C ☐ HDS-300™ Hardware/Software Development Station
- D ☐ M68000KIT
- E ☐ M68000 Family PLCC Packaging
- F ☐ M68000 Family Audio Cassette Training Courses
- G ☐ Literature Packs:
  - 1 ☐ M68KPAK (General Family)
  - 2 ☐ M32BITPAK (Family 32-bit)
  - 3 ☐ M68KCOMPAK (Communications)

To: Motorola Semiconductor Products, Inc.
P.O. Box 20912, Phoenix, AZ 85036

330BYTE100087

Name _____

Title _____

Company _____

Address _____

City _____

State _____ Zip _____

Please call me (_____) _____

ASK BYTE

Conducted by Steve Ciarcia

CAD Programs

Dear Steve:

I am looking into how to interface a computer-aided-design (CAD) program for an IBM PC–style computer with computer-numerical-control (CNC) machines. I would like to study the CNC programming practices and languages that are being currently used. I understand that MAP (manufacturing automation protocol), developed by General Motors, is gaining some acceptance.

I would be grateful for any sources you could give me to learn more about these or related subjects.

Thaddeus M. Sendzimir
Waterbury, CT

Basically, mechanical CAD packages produce a database containing all the dimensional information for the part. A separate program digests that database and produces a file that directs the CNC machine's motors to move the tool and workpiece in the right direction at the right time.

Unfortunately, there are no standards for the format of the CAD database, the instructions that the CNC tools expect to see, or the method you use to get the two talking together. That's the motivation behind MAP, which was supposed to set up some solid standards. Unfortunately, GM is finding that it's bitten off far more than it can chew: MAP is running into some serious schedule slips and general confusion.

One of MAP's big selling points was that it could connect everything to everything else. You might want to start out a lot smaller, with only a few tools at first. This gives you a chance to find out the advantages (and the problems) of complete automation without betting the whole company on someone else's ability to make everything work.

Fun though it is to play around making serious machinery take heavy cuts and spit big blue hot curly chips, I don't think this is a roll-it-yourself topic. There are too many subtle issues involved in getting it to work without wrecking something expensive along the way.

The general-purpose CAD program isn't suitable for this sort of work; you need full-blown three-dimensional solid modeling capability. The number of computations and display resolution required for that puts the hardware out of the PC or AT class and into the engineering workstation class. Of course, the price goes up along with the performance.

Probably the best starting point is to call up the folks who sell machine tools and pick their brains on CNC hookups. I suspect you'll find that they have a package that bolts a specific CAD package to a specific CNC machine, or perhaps to a family of similar machines. A general connection from a given CAD package to all the machines you're planning to use will be more difficult to get.

Ask what CAD programs are compatible with which CNC machines. When you get the same answer from more than one vendor, invite that CAD company in for a talk, and ask what tools they drive. Eventually, you'll figure out who's doing what. Ask for references, and be sure to follow them up: Talking with someone who's already done it is worth more than my advice any day. What you should be interested in is a complete packaged system rather than the details of exactly how the drawings get translated into tool paths. There are enough traps at your level to ruin your day.—Steve

Incompatible Compatibles

Dear Steve:

My organization bought a few Corona PCs because they were IBM PC–compatible. However, the staff encountered some problems when they created WordStar files on a Corona and tried to read them on IBM PCs or other compatibles.

Specifically, WordStar text files that were saved on a Corona and stored on a floppy disk seemed corrupted when they were read on IBM PCs or other compatibles: Part of a file (a page or a few paragraphs) would be missing or would be composed of peculiar characters. Sometimes WordStar would read in files other than the ones we specified.

Likewise, when a text file was created on other machines, it appeared corrupted when it was read by a Corona PC.

I would be grateful if you could help us identify the problem.

Yeo Pee Pin
Republic of Singapore

Your problem with WordStar files may be due to using different versions of DOS, the disk operating system, which you use to initially boot up the computer. The symptoms you describe appear when a disk created by DOS 2.0 or higher is used on a computer running DOS 1.0 or 1.1.

To avoid this type of problem, you should standardize on a later version of DOS (say 2.1) for all machines. Be sure that any system disks or boot disks used on the various computers are all DOS 2.0 or higher.

If this is not possible, remember that a computer running DOS 2.0 can use a disk created by DOS 1.1, but a computer running DOS 1.1 cannot use a disk created on a computer running DOS 2.0. You can determine the version of DOS running on a computer at boot time, when the DOS "signs on" with its version number. To determine under which version a disk has been formatted, use the `CHKDSK` *command. A disk formatted with DOS version 1.1 will report a disk capacity of 320K bytes (160K bytes if single-sided), while a disk formatted with DOS 2.0 or higher will report a capacity of 360K bytes (180K bytes if single-sided).*

To make use of WordStar files created under DOS 1.1, you should boot your computer with DOS 2.1 in drive A:, format a blank disk in drive B:, replace the disk in drive A: with the old disk containing your WordStar files, and then use the `COPY` *command to transfer your WordStar files on A: to the newly formatted disk in drive B:. You can then reformat the old*

continued

IN ASK BYTE, Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to

Ask BYTE
c/o Steve Ciarcia
P.O. Box 582
Glastonbury, CT 06033

Due to the high volume of inquiries, we cannot guarantee a personal reply, but Steve and the Ask BYTE staff answer as many as time permits. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

The Ask BYTE staff includes manager Harv Weiner and researchers Eric Albert, Bill Curlew, Ken Davidson, Jeannette Dojan, Jon Elson, Roger James, Frank Kuechmann, Dave Lundberg, Tim McDonough, Edward Nisley, Dick Sawyer, Andy Siska, Robert Stek, and Mark Voorhees.

News about the Microsoft Languages Family

Optimizing Your Programs with the Microsoft® C Optimizing Compiler Version 5.0

Fast execution speed is the single most important feature of a C compiler. Volume 2, Number 2 of the Microsoft Languages Newsletter talked about the optimizations available in Microsoft C Version 4.0. Microsoft C Version 5.0 takes these optimizations further. For example,

```
for (i = 0; i < 25; i++)          becomes          tmp = a*b;
        array[i] = a*b;                            for (i = 0; i < 25; i++)
                                                   array [i] = tmp;
```

Since a and b are not affected by the loop, they are moved outside of the loop. This optimization is called *invariant code motion.* The Microsoft C Optimizing Compiler also uses instructions available on the 8086 to optimize specialized loops. Initialization and memory movement loops are two examples. The optimizer generates REP STOSW and REP MOVSW instructions for

```
int i, x[25];                     and              int i, x[25], y[25];
for (i = 0; i < 25; i++)                           for (i = 0; i < 25; i++)
        x[i] = 0;                                          x[i] = y[i];
```

The following example is more complicated. The optimizer rewrites array references as pointer references because they are more efficient.

```
int i, x[25];                     becomes          int i, x[25], *ptr;
for (i = 0; i < 25; i++)                           for (i = 0, ptr = x; i< 25; i++, ptr++)
        x[i] = i*4;                                        *ptr = i*4;
```

Then the optimizer puts key variables in registers using *loop enregistering* and changes the loop incrementation using a process called *strength reduction.* The loop becomes

```
int i, x[25];
i = 25;
{
        register int j;
        register int *ptr;
        for (j = 0, ptr = x; j < 100; j + = 4, ptr++)
                *ptr = j;
}
```

The final form of the loop uses registers for key values and exchanges addition instructions for multiplication instructions. Here is the output of the Microsoft C Optimizing Compiler in 8086 assembly code.

```
        mov     WORD PTR [bp-52], 25    ; set final value of i to 25
        mov     di,bp
        sub     di,50                   ; load pointer to x
        sub     si,si                   ; set temporary register variable to 0
                                        ; this variable is used as the loop counter
$L20000:
        mov     WORD PTR [di], si       ; set the array value
        add     di,2                    ; increment pointer by 2
        add     si,4                    ; increment loop counter by 4
        cmp     si,96                   ; check if we are at the end of the loop
        jle     $L20000
```

What is the result of these optimizations? Programs compiled with Microsoft C Version 5.0 run 15 to 30 percent faster than those compiled with Version 4.0.

For more information on the products and features discussed in the Newsletter,
write to: Microsoft Languages Newsletter
16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717.
Or phone:
(800) 426-9400. In Washington State and Alaska, call (206) 882-8088. In Canada, call (416) 673-7638.

Latest DOS Versions:	
Microsoft C Compiler	5.00
Microsoft QuickC	1.00
Microsoft COBOL	2.20
Microsoft FORTRAN	4.01
Microsoft Macro Assembler	5.00
Microsoft Pascal	3.32
Microsoft QuickBASIC	3.00

Look for the Microsoft Languages Newsletter every month in this publication.

Microsoft®

disk under DOS 2.1 for future use.

I hope this helps solve your problem. —Steve

Driven Crazy by Drivers

Dear Steve:

Someone has said: "Only the rich can afford to buy anything cheap, because if it does not suit their needs, they can simply throw it away." This is so true for those of us who love computers but do not have the time or the inclination to program them. I find it particularly true of printer drivers.

I need a driver or other instructions to use the full power of both the Amiga and my new Panasonic KX-P1092 printer. I also have Micros System's Scribble 2.0 (an excellent value, by the way). I need a printer driver that is simple enough for a novice to install. Hopefully, one driver will work with both Scribble and the Amiga.

George Offenbacher
Port Clinton, OH

To use your Panasonic printer with the Amiga, you need an Epson printer driver. Fortunately, this driver is included with your system, and you can select it from the Preferences menu. Just change the printer selection to Epson, and your printer should work fine. Be sure to save your preferences after you make the change.—Steve

CB86 and Cursor Keys

Dear Steve:

I have some programs written in CB80, Digital Research's 8-bit compiled-BASIC language. I have recompiled these programs under CB86 to run on the Compaq computer. Everything works fine, except that I cannot read the cursor keys. I think that the Compaq is sending an ASCII 0 followed by another character whenever I press a cursor key, but that the CB86 program cannot pick up the character 0 and only picks up the following character.

Is there something I'm overlooking, or is there another way to pick up the use of the cursor keys besides using CB86's `INKEY` function?

Weldon Bailey
Kingwood, TX

You're absolutely right about the way the cursor keys work. IBM picked a two-character code to represent the keys that didn't have good ASCII equivalents, with the first character of the pair being ASCII 0. The second character is a standard ASCII character that, except for the leading null, is indistinguishable from the code produced by some other key.

For example, the cursor keys produce these codes: left arrow = <null> K; right arrow = <null> M; up arrow = <null> H; and down arrow = <null> P. IBM's `INKEY$` *function returns a string that contains none, one, or two characters. If no key was pressed, there will be no characters in the string. An ordinary key will return the single ASCII character that you'd expect. The extended keys (such as cursor or function keys) return two characters, the first of which is always a null.*

Now, I don't know exactly how CB80 and CB86 work, but what you suspect may well be happening. You could try putting the `INKEY` *in a loop, printing out the length of the result as well as the actual characters and their numeric equivalents. That should tell you something.*

One possibility is that CB86 uses a null to represent "no key pressed," in which case you're sunk without a trace. You could write a small assembly-language program that would grab the keyboard interrupt back from BASIC and perform the same function as `INKEY`*, but that's a pretty tricky project.*—Steve

DOS EXEC

Dear Steve:

I have been in the software field for about two years, developing application software in COBOL and BASIC for business purposes. During this time I have often encountered cases where it would be useful to be able to execute DOS commands from within my programs.

I am not an expert in assembly language. Nevertheless, it would be most helpful if you could at least point me in the right direction. Could you also suggest any assembly language books that could help me in developing assembly routines for other purposes?

Floyd D'Aguiar
Bombay, India

A program executes DOS commands from within itself by using the DOS function called EXEC. This function loads and passes control to a specified program. That program can be another copy of the command interpreter (`COMMAND.COM`*), with a command line set up to execute an internal or external command.*

The EXEC function is tricky, and the standard DOS documentation is woefully inadequate. Advanced MS-DOS *by Ray Duncan (Redmond, WA: Microsoft Press, 1986) has a 20-page description of the command, including an example program and a two-page summary with a number of caveats. PC DOS 2.0 and 2.1 had some crippling bugs in the EXEC code, so if you're using either of them, it may be time for an upgrade.*

continued

SOFTWARE

PC COMPATIBLE SOFTWARE

AMERICAN SMALL BUSINESS
Prodesign II $169.00

ANSA
Paradox $359.00

ASHTON-TATE
D Base III+ $389.00
FrameWork II $389.00
Multimate Advantage II ..... $CALL
Rapidfile $244.00

BOEING
Boeing Calc ..... $CALL
Boeing Graph ..... $CALL

BORLAND
Eureka ..... $CALL
Reflex $84.95
Reflex Workshop $44.95
Sidekick(unprotected) $47.00
Sidekick/Traveling
Sidekick Bundle $74.95
Superkey $37.00
Travelling Sidekick $42.95
Turbo C ..... $CALL
Turbo Database Toolbox $42.95
Turbo Gameworks $39.00
Turbo Graphix Toolbox $31.00
Turbo Jumbo Pack $177.00
Turbo Lightning $54.95
Turbo Pascal $59.00
Turbo Pascal
Numerical Methods $59.00
Turbo Prolog ..... $CALL
Turbo Prolog Toolbox $57.95
Turbo Tutor $27.95

BRODERBUND
Graphics Library $25.95
Graphics Library Disks $24.95
Newsroom Pro $69.95
Print Shop $39.95
Print Shop Companion $32.00
Toy Shop $42.95

CENTRAL POINT SOFTWARE
COPY II PC $27.00
Option Board $79.95
PC Tools $27.00

DAC SOFTWARE
Dac Easy Accounting $54.95
Dac Easy Acct. Tutor $19.95
Dac Easy Payroll. $39.95

DAYBREAK
Silk ..... $CALL

ELECTRONIC ARTS
Call for price on all titles!

EPYX
Call for price on all titles!

FUNK
Sideways $37.95

GENERIC SOFTWARE
Generic Cadd 3.0 ..... $69.95
Generic Cadd w/Dot Plot $89.95

INFOCOM
call for price on all titles!

LIFETREE
Volks Writer $157.00
Words & Figure $137.00

LIVING VIDEOTEXT
Ready! $52.95
Think Tank $97.95

LOTUS
123 ..... $307.00
HAL ..... $CALL
Symphony $439.00

MECA
Managing Your Money $119.95

MERIDIAN TECHNOLOGY
Carbon Copy $109.00

MICROPRO
Wordstar 2000 ..... $199.00
Wordstar 2000+ $219.00
Wordstar Prof Rel 4 ..... $249.00

MICRORIM
R Base System 5 ..... $427.00
Clout $124.00

MICROSOFT
Access ..... $CALL
C Compiler $249.00
Chart $164.00
Flight Simulator $32.95
Fortran $267.00
Macro Assembler $87.00
MS-DOS & GW Basic ..... $CALL
Mouse $109.00
Pascal $167.00
Project $227.00
Quick Basic $57.00
Windows $57.00
Word $279.00

MICROSTUFF
Crosstalk XVI $94.00

NORTON PRODUCTS
Norton Commander $39.95
Norton Utilities $49.95
Norton Advanced Utilities $84.00

PAPERBACK SOFTWARE
VP Planner $52.95
Executive Writer $39.95
Executive File $29.95
VP Graphics ..... $CALL
VP Expert ..... $CALL
VP-Info $59.00

PERSONICS CORP
Smart Notes $47.95

ROSESOFT
Prokey $74.00

SOFTWARE PUBLISHING
Harvard Total PM $257.00
Harvard Presentation Graphics $229.00
PFS First Choice $94.00
Professional File $139.00
Professional Plan ..... $CALL
Professional Write $109.00

SIMON & SCHUSTER
Typing Tutor III $39.95

SPRINGBOARD
Newsroom Pro $79.00
Clip Art ..... $CALL

SYMANTIC
Q&A $21.00

TURNER HALL
Note It $57.00
SQZ $57.00

WORD PERFECT
Wordperfect $207.00
Executive $127.00
Library $79.00
Math Plan ..... $CALL

XEROX
Ventura Publisher ..... $CALL

HARDWARE

PRINTERS

CITIZEN
120D $174.00
MSP-10 ..... $279.00
MSP-15 ..... $379.00
Premier 35 ..... $459.00
Tribute 224 ..... $CALL

EPSON PRINTERS
FX-86E $317.00
FX-286E $447.00
LX-800 ..... $179.00
LQ-800 ..... $447.00
LQ-1000 ..... $627.00
EX-800 ..... $387.00
EX-1000 ..... $497.00
GQ-3500 LASER $1499.00
CALL FOR PRICE ON EPSON COMPUTERS

PANASONIC PRINTERS
1080i $159.00
1091i $189.00
1092i $279.00
1592 ..... $389.00
1595 ..... $439.00
3131 ..... $259.00
3151 ..... $399.00
Laser Printer ..... $CALL

STAR MICRONICS
NP-10 ..... $134.95
NX-10 ..... $157.95
NX-15 ..... $349.00
ND-10 ..... $289.00
ND-15 ..... $429.00
NR-15 ..... $499.00
NB24-10 ..... $499.00
NB24-15 ..... $639.00

MONITORS

TTL Monochrome
Amdek 410A Amber, Green,or White $149.00
Blue Chip Green $89.00
Packard Bell Amber w/std. $97.00
Samsung TTL $89.00
Xtron Amber TTL/CGA autoswitch $119.00
Zenith 1240 ..... $139.00

RGB
Magnavox 8562 ..... $269.00
Magnavox 515 ..... $289.00
Thompson...All Models .... $CALL
Zenith 1330 ..... $407.00

EGA
NEC Multisync $549.00
Packard Bell EGA/CGA/TTL Auto $419.00
Amdek 722 ..... $477.00
Thompson Ultrascan $499.00
Zenith 1470 EGA $219.00

Kensington Accessories In stock!!! Call for Best Price

PC ADD ON BOARDS

AST
Advantage(128k) $319.00
Rampage AT $419.00
Rampage PC 6 Pak +(64k) ..... $CALL
I/O Mini II $159.00

ATI
Graphic Solution $187.00
EGA Wonder $274.00

BOCA RESEARCH
EGA/CGA/MDA/MCA $149.00
BOCARAM XT w/0K $139.00
BOCARAM AT w/0K $169.00
Bocarams are Intel Above Board compatible
BOCA I/O AT $79.95
BOCA I/O XT $79.95
Gameport Adapter for I/O $19.95

HERCULES
Graphics Plus $179.00
Color Card $147.00
Other Hercules boards in stock... Call for price

INTEL
AboveBoard PC $227.00
AboveBoard PS/XT $267.00
AboveBoard AT $339.00

KEYSTONE TECHNOLOGIES
Add on Cards
-Compatibility guaranteed
-1 year replacement warranty
CGA card w/printer port $69.95
Hercules Compatible Mono card w/printer Port $69.95
Multi I/O ..... $CALL
for configuration and price

PARADISE
Autoswitch ..... $CALL

STB
EGA+ $259.00
Chauffer HT $214.00

ZUCKER
CGA $89.95
Monochrome Graphics $94.95
Memory Expansion ..... $CALL

PC HARD DRIVES

Miniscribe
30MB XT Drive w/controller $339.00
30MB Hard Card $379.00
40MB AT Drive $379.00

Seagate
ST-225 20MB w/controller $289.00
ST-238 30MB w/controller $359.00

AT Hard Drives
ST-4038 ..... $549.00
ST-251 ..... $469.00

Western Digital
File Card 20 ..... $439.00
File Card 30 ..... $CALL
AT FD/HD Controller $169.00

IMSI
PC mouse w/Dr. Halo II $104.00

MODEMS

Hayes Smart Modem
1200B w/sw $329.00
2400B w/sw $499.00
Keystone Technologies 1/2 Card Internal 300/1200,Includes PC Talk III software $89.00
2400 baud Internal $199.00
Packard Bell External
300/1200 baud $149.00
2400 baud External $279.00
US Robotics Sportster
300/1200 baud $139.00
Ventel Modems
Call for best prices on all models
Zucker
300/1200 Half Cd Modem with software $87.00

CHIPS

Numeric Coprocessors
8087 ..... $104.00
8087-2 ..... $147.00
80287 ..... $179.00
80287-2 ..... $CALL

Memory Chips
64k - 120 or 150ns
64k x 4 120 or 150ns
256k - 120 or 150ns
PRICES ARE TOO VOLATILE TO LIST! PLEASE CALL FOR CURRENT PRICE.

DISKS

per box of 10		3.50"	5.25"
BONUS	DS/DD	-	$6.95
MAXELL	DS/DD	$17.95	$9.95
VERBATIM	DS/DD	$19.95	$9.95
SONY	DS/DD	$16.95	$8.95

DON'T SETTLE FOR LESS...

tcp SHIPS IT

FEDERAL EXPRESS®

Software orders over $50 & Accessories/Peripherals under 8 pounds will be shipped FEDERAL EXPRESS
(Yes even at these prices). You only pay TCP's standard shipping charge of $4.00 per order. Orders arriving before 11:00 AM our time will be shipped out same day.If part of your order is backordered the remainder will be shipped UPS Ground for FREE.

TOLL FREE 1-800-468-9044

INFORMATION AND PA ORDERS 814-234-2236

OPEN: 8:00AM-9:00PM Mon-Fri
10:00AM-6:00PM Sat-Sun EAST COAST TIME

tcp XT 10

■ 10MHz with 0 Wait State. ■ 640 KB RAM (120 nano-seconds) on motherboard. ■ 150W Power Supply. ■ 8 Expansion Slots. ■ (2) 360K Floppy Drives (Room for 2 additional 1/2 height devices). ■ 101 Key, Enhanced AT Style Keyboard with IBM® type mechanical "touch-click"feel. ■ Reset and Turbo Buttons plus Keyboard Keylock on front panel. ■ Hercules compatible monographic card (720 x 348). ■ Packard-Bell High Resolution Amber Monitor with tilt and swivel. ■ Parallel and Serial Ports, Clock/Calender w/Battery Back-up. ■ MS DOS v3.21/GW Basic Option **$79.95.** **HARD DRIVE OPTION:** Same as above but w/single Floppy Drive, 30MB Hard Drive and Controller. Introduction Price **$949.00**

tcp price ~~$769.00~~
Limited Introductory Offer
$699.00

Buy with Confidence, 30-Day Satisfaction Guarantee

AMSTRAD

PC-1512
Full PC Compatibility
Plus ■ 8MHz Processor ■ 3 Available Slots ■ 512K Memory ■ Parallel Port, Serial Port, Game Port Standard ■ Microsoft Compatible Mouse ■ MS-DOS 3.2, GEM Desktop, GEM Basic 2 ■ CGA Video Card

CALL FOR BEST PRICE IN THE USA

TOSHIBA

3 1/2" DRIVE, 720 K, Requires DOS 3.2 or higher
Includes Mounting Hardware..... $129.00

EDUCATIONAL & CORP ACCOUNTS
CALL 1-800-533-1131
Inside PA Call 814-234-2236

To order by mail: We accept money order, certified check, personal check. Allow 2 weeks for personal check to clear. Shipping: $4.00 for software and accessories/ $10.00 for printers and color monitors/ $8.00 for disk drives and other monitors/ Add $3.00 per box shipped COD. Call for other shipping charges. Additional shipping required on APO, FPO, AK, HI, and foreign orders.
Terms: ALL PRICES REFLECT CASH DISCOUNT, ADD 1.9% FOR MASTERCARD OR VISA.
All products include factory warranty.
ALL SALES ARE FINAL. Defective items replaced or repaired at our discretion. Pennsylvania residents add 6% sales tax. Prices and terms subject to change without notice.

TUSSEY COMPUTER PRODUCTS P.O. BOX 1006 STATE COLLEGE, PA 16804

The more th
the more they

1971. Kansas tornado blows out DEC™ PDP-IIs. Files saved on 3M data cartridge tape.*

1972. Moonlighting programmer deprograms company's production records. Files saved on 3M data cartridge tape.

1973. Fastidious janitor turns off IBM® 370. Files saved on 3M data cartridge tape.

1978. Colorado electric storm jolts Wangs.® Files saved on 3M data cartridge tape.

1979. Little Stevie Fong flips floppies out father's office window. Files saved on 3M data cartridge tape. .

1980. Temporary help permanently dumps accounting records on Apple III. Files saved on 3M data cartridge tape.

1984. Hard disk fails in soft market; brokers panic. Files saved on 3M data cartridge tape.

1985. Sal's Diner. Dropped eggs scramble Macs.™ Files saved on 3M data cartridge tape.

1987. Delivery boy delivers IBM PS/2™ swiftly and abruptly to the sidewalk. Files saved on 3M data cartridge tape.

ngs change, stay the same.

1975. Head of the office trips, pulls plug on HP® 3000. Files saved on 3M data cartridge tape.

1976. Unnamed computer does the unmentionable. Files saved on 3M data cartridge tape.

1977. Office fire bakes Apple® IIs. Files saved on 3M data cartridge tape.

1981. Circuit breaker flips, floppies flop. Files saved on 3M data cartridge tape.

1982. Head crash proves fatal to Lisa.™ Files saved on 3M data cartridge tape.

1983. Thief sneaks away with Osbornes.® Files saved on 3M data cartridge tape.

1990. Somewhere, somehow, on some computer, data will crash. Files will be saved on 3M data cartridge tape.

Computers come, and computers go.

But when they go out abruptly, you've always been able to rely on 3M data cartridge tape for backup.

In fact, 80% of the people who back up on data cartridge tape back up on 3M.

Why?

We've been covering computer and human errors almost longer than computers and humans have erred together.

Not only did we invent and patent data cartridges, we've continually patented the innovations that make data cartridge backup the best way to back up data.

Which is something that's never changed.

Call (800) 423-3280 for a brochure.

3M

Worldwide Sponsor 1988 Olympic Games

You'll need to figure out a way to pass control to an assembly routine that will release the excess storage allocated to your COBOL or BASIC program. I'm not sure how to do this with the compilers you're using, but I think it will be a little messy because neither language was intended for this sort of application. Duncan's book details what to do with C and assembler programs, so you may be able to figure out how to use it with your languages.—Steve

Printer Problems

Dear Steve:

The problem I'm having is with a printer interface between a Tandy DMP-2100 (not to be confused with a DMP-2100P) printer and IBM PC XT and AT compatibles. I purchased a cable from Radio Shack that purports to properly connect the Tandy 1200 and IBM PC to designated Radio Shack printers, one of which is the DMP-2100.

When I got everything connected and executed a Shift-Print Screen, I got a perfect screen dump to the printer. Also, when I use WordStar 2000 Plus Release 2.0, which includes a Tandy DMP-2100 printer driver, I get printed output as expected. All this would tend to make me think the cable is functioning.

However, when I type Control-P at the DOS prompt, which should echo the screen output to the printer, I get a message that reads:

```
Write fault error writing device PRN
Abort, Retry, Ignore?
```

Interestingly enough, this message prints out perfectly on the printer. Any ideas?

Eugene W. Hungate
Elkhart, IN

You wouldn't believe the number of letters I get from people who have a printer, a PC, a cable, and no characters on the page. You're ahead of the crowd so far.

Not having your collection of equipment handy, I did a little tinkering around with a PC AT and an ordinary IBM graphics printer. The `Write Fault` *error cropped up when I tried printing something while the printer was set offline.*

That was the easy part; now comes the deductive logic. I assume, incidentally, that you've made sure that the printer is ready to go, and that you have the cable securely fastened at both ends when you press Control-P. (I make those mistakes, too, by the way.)

If the DMP-1200 is particularly slow, it may be that the print routines give up in disgust. Because DOS, BIOS, and the WordStar driver code can all use different time-out values and retry counts, it's conceivable that everything but the BIOS code works just fine. Take a look at what the printer is doing when the error message occurs. If it's always feeding a line or returning the print head to the left margin, that's a sure sign of a timing problem.

You don't mention which compatible you're using, but if it's a souped-up PC or an AT, the timing problem will be worse. You might want to try a slower machine just to see if the problem will clear up.

You can try changing the BIOS time-out value to a larger number. This would cause all the code that uses the BIOS to wait a little longer before concluding that there's an error. This may or may not help, because I don't know exactly where the error is coming from. Use DEBUG and follow this script:

```
A> DEBUG
-D40:78L1
0040:0078 14
-E40:78 40
-Q
(Return to DOS)
```

The above steps show how to change the time-out value stored at address 0040:0078 from 20 decimal to 64 decimal (numbers given by DEBUG are in hexadecimal). Now try the Control-P trick and see if it works. If so, then the following simple BASIC routine should also fix the problem. Just put the program name into your AUTOEXEC.BAT so that it's run every time you boot your PC, and the problem will be solved.

```
10 DEF SEG &H40
20 POKE &H78,64
30 SYSTEM
```

Store this program in file PRTFIX.BAS and add a line to your AUTOEXEC.BAT file that reads:

```
BASICA PRTFIX
```

I hope this helps, because if it doesn't . . . I'm fresh out of ideas!—Steve

CIRCUIT CELLAR FEEDBACK

Where It's AT

Dear Steve:

I'm interested in building some gadgets to plug into my IBM PC slots. From your last few articles in BYTE, it's obvi-

continued

"Incredible performance for the price."
—PC Magazine

Drafix 1 Plus. The easy way to become a sophisticated CAD user.

Some CAD packages give you powerful features. Others promise ease of use.

Only one gives you both. New Drafix 1 Plus.

High performance CAD you'll be using in minutes.

Drafix 1 Plus features a unique menuing system that was created to work with, not against, the way you design.

All of the menus are visible all of the time, options are automatically displayed, everything is smooth, natural, easy to use.

In minutes you'll be able to create sketches and drawings that would take weeks to learn on any other CAD system.

High performance CAD you'll be using for years.

At the same time Drafix 1 Plus offers all of the drawing, designing and editing functions demanded by the most serious users such as architects and engineers.

Text editing window, function key macros, splines, automatic dimensioning—Drafix delivers the full function CAD power only found on the most sophisticated systems, at a fraction of their cost.

Order today. Only $295.

Your Drafix 1 Plus package includes both Dot Plotter (to give you high resolution output on over 100 dot matrix and laser printers) and our library of 450 time-saving pre-drawn symbols.

All for the remarkably low price of just $295.

Order new Drafix 1 Plus today. You'll be using it in minutes. And you'll appreciate it for years.

"est CAD buy in town."
-PC CAD A Buyer's Guide

Drafix adds a new dimension! Introducing Drafix 3-D Modeler. Also just $295!

Introducing new 3-D Modeler. Its true 3-D database allows you to easily create a three-dimensional computer model and generate unlimited perspective views. Set your eye location and viewing target, then view the model from any angle—inside and out!

Drafix 3-D Modeler has the same features found in the product rated the ***#1 3-D CADD*** *in the 1986 AIA CADD Review.*

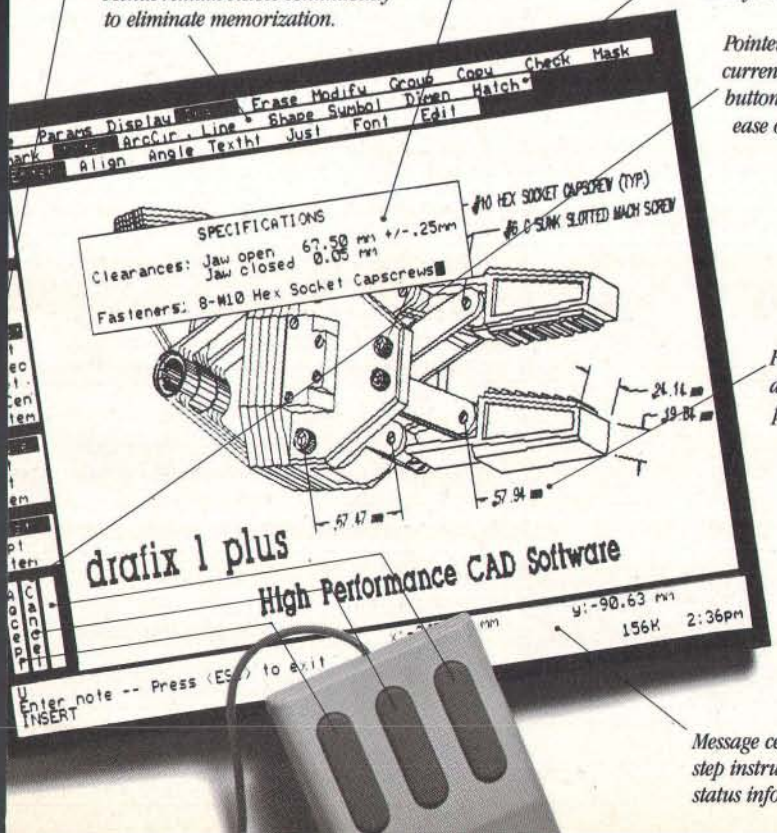
Item attributes, component and grid snaps can be selected on the fly for speed and accuracy.

Pop-up text editing window to enter, edit and rearrange even large blocks of text.

Powerful drawing functions include splines, arcs, cross-hatching, solid fill, parallel and perpendicular lines, and many others.

Menus remain visible continuously to eliminate memorization.

Pointer prompts display current mouse or digitizer button functions for ease of use.



Flexible automatic dimensioning system is powerful, easy to use and adaptable to your work style.

Message center displays step-by-step instructions and other useful status information.

Call for the name of your local Drafix dealer or place your Toll-Free order today!

1-800-231-8574
Ext. 150

Use Visa, MasterCard or American Express

Drafix 1	(Now just $195)
Drafix 1 Plus	$295
OTTO (AutoCad File Exchange)	$95
Professional Symbols Libraries	$150
Drafix 3-D Modeler	$295
Mouse Systems Mouse with any Drafix package	$100

Note: Drafix 3-D Modeler must be used with Drafix 1 or Drafix 1 Plus for plotter or printer output.

Drafix supports IBM PC/XT/AT and compatibles. Ask about Drafix 1/Atari ST software.

FORESIGHT RESOURCES CORP.™
932 Massachusetts
Lawrence, KS 66044 913-841-1121

Circle 99 on Reader Service Card

ous you know how it's done. Is there one book you could recommend that gives the bus transfer protocols between the operating system and those card slots? What do you use for authoritative source documentation? I'm particularly interested in setting up something like a disk controller as a smart-file transfer interface to another system.

Also, I'm really tempted by the low prices on some of the PC AT compatibles. Is there a good source of wisdom on the AT slot-protocol peculiarities?

Any advice that you could give would be greatly appreciated. I know nothing about those slots now, and I'm hoping that I won't have to go through 12 different documents before I find one that gives the information I want. Sampling books here in Berlin is not as easy as browsing in the stores back home.

James L. Barnett
USAFS Berlin, Germany

Actually, the way you find out how the IBM PC bus works is to build something, then figure out why it doesn't work. There are a lot of tricks and "gotchas" that aren't written down anywhere.

Probably the best references are the IBM technical reference manuals for the PC and the AT. While they're short on timing diagrams and explanations, they have the schematics for all the IBM PC adapters so you can see how the logic is put together. IBM tends to use ordinary TTL gates rather than custom logic for the bus decoding and buffering, so you can easily reproduce IBM's logic in your own designs.

I'm not sure how you'd go about ordering these documents from Berlin, but here in the U.S. you can get them from authorized IBM PC stores or by ordering them from

IBM Technical Directory
P.O. Box 2009
Racine, WI 53404-3336

They take checks, money orders, or credit cards (no cash, postal orders, or CODs), and probably require payment in U.S. funds. The manuals you need are

AT Technical Reference, *Part No. 6280070, Form No. S229-9611-00, $105.*

AT Technical Reference Update, *Part No. 6280099, Form No. S229-9608-00, $49.75.*

XT Technical Reference, *Part No. 6290089, Form No. S229-9607-00, $49.75.*

PC Technical Reference, *Part No. 6322507, Form No. S229-9610-00, $30.*

continued

Why you should buy a mouse with no moving parts. Now.

Several reasons. No moving parts. No problems. And $20 comes back to you.

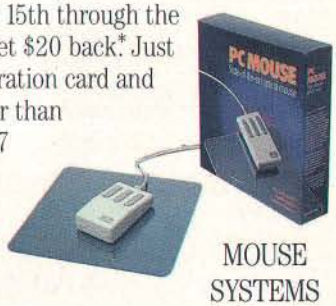
The PC Mouse has no moving parts. It is an optical mouse. It's faster. More accurate. And so reliable, it's the only mouse with a **Lifetime Warranty.** Other mice, like the ones from IBM and Microsoft® have a rolling ball, little teeny bearings and shafts and lots of other moving parts. Which make a mechanical mouse less reliable. Less accurate.

The PC Mouse gives you digital accuracy and superior software compatibility. PC Mouse works with any software package written for use with a mouse and quite a few that aren't. Designer Pop-up™ menus come FREE with every PC Mouse. Designer Pop-up menus include over 20 pre-configured menus for the most popular software programs, like Lotus 1-2-3. You also get an easy to use application so you can create your own menus for software programs not originally designed to use a mouse.

The PC Mouse from Mouse Systems comes in three models: PC Mouse (serial), PC Mouse Bus Plus (it comes with a serial Bus card) and our *NEW* PC Mouse PS/2 (for the IBM Personal System/2™).

And from September 15th through the end of December you can get $20 back.* Just send us your receipt, registration card and this ad, postmarked no later than midnight December 31, 1987 and we'll send you $20.

PC Mouse.
No moving parts.
No problems.



MOUSE SYSTEMS

**This offer applies only to the Mouse Systems' PC Mouse product brand.*

CIARCIA FEEDBACK

PCjr Technical Reference, *Part No. 1502293, Form No. S229-9612-00, $35.*
Options & Adapters, *Part No. 6322509, Form No. S229-9612-00, $125.*
EGA Technical Reference, *Part No. 6280131, Form No. SS34-0007-00, $9.95.*
Engineering/Scientific, *Part No. 6280133, Form No. SS34-0009-00, $27.95.*
AT Options & Adapters, *Part No. 6280134, Form No. SS34-0010-00, $9.95.*

The options and adapters technical reference manuals contain the adapter cards. The other volumes contain just system-board and BIOS information. I suggest that you get the XT and AT system reference manuals and the options and adapters volumes for the cards you're interested in. The BIOS listings are particularly useful for figuring out how a program actually uses the hardware.

Some of the prices look like misprints, but they're not. It isn't clear why the original PC Options & Adapters *volume is $125 and the* AT Options & Adapters *volume is $9.95. The* EGA Technical Reference *manual originally cost about $100, and its price has dropped dramatically. Still, you may want to contact the Technical Directory to verify current prices and form numbers.*

Most AT compatibles are very compatible at the bus level—that lesson was learned by the early not-quite-compatibles. The only trick is coping with the higher clock rates: Anything over 8 megahertz tends not to work with some popular expansion cards.

You will need a good oscilloscope if you're serious about this. Sometimes just sitting down, writing a short assembly-language test loop, watching the scope, and sketching what's going on is more rewarding than reading many chapters in some manual. Good luck!—Steve ■

Between Circuit Cellar Feedback, personal questions, and Ask BYTE, I receive hundreds of letters each month. As you might have noticed, in Ask BYTE I have listed my own paid staff. We answer many more letters than you see published, and it often takes a lot of research.

If you would like to share your knowledge of microcomputer hardware with other BYTE readers, joining the Circuit Cellar/Ask BYTE staff would give you the opportunity. We're looking for additional researchers to answer letters and gather Circuit Cellar project material.

If you're interested, let us hear from you. Send a short letter describing your areas of interest and qualifications to Steve Ciarcia, P.O. Box 582, Glastonbury, CT 06033.

COMPUTER WAREHOUSE

CALL TOLL FREE 1-800-528-1054

FREE FEDERAL EXPRESS **Air Express Shipping**
See Details Below

LOWEST PRICES FAST DELIVERY

HARDWARE

PRINTERS

Alps All Models	Call
Brother All Models	Call
Citizen MSP-10	$249
MSP-15	$315
MSP-20	$285
MSP-25	$385
Premier 35	$445
Tribute 224	$619
120 D	$159
Diablo 635	$759
Diconixs 150	$299
EPSON All Printer Models	Call
Hewlett-Packard LazerJet II	$1859
NEC P2200	$335
850	$1539
860+	$1935
3510, 3550	$729
8810, 8850	$1059
P6	$429
P7	$619
P9	$1159
OKIDATA All Printer Models	Call
Panasonic NEW 1080	Call
NEW 1091	Call
1092 I	$295
1592	$375
1595	$419
3131	$229
3151	$369
STAR MICRONICS All Printer Models	Call
Toshiba 321 SL	$509
341E Parallel	$595
351 Model II	$899
Laser Printer	Call

DISKETTES

Maxell MD2 (Qty 100)	$82.50
M2S	$65
Sony MD/2 (Qty 100)	$80

MONITORS

Amdex All Monitors	Call
NEC Multisync	$545
Multisync Plus	Call
Multisync Graphic Board	Call
Princeton Graphics All Models	Call
Sony Multiscan w/cable	$585

VIDEO TERMINALS

Qume 101 Plus Green	$315
101 Plus Amber	$315
Wyse 30	$285
50	$359
75	$565
Wyse 85	$425

MODEMS

HAYES All Modems	Call
Prometheus All Models	Call
US Robotics Courier 2400	$335
Password 1200	$149
Microlink 2400	$335
Ventel	Call

DISK DRIVES

Iomega Bernoulli 10 meg	$865
Bernoulli 20 meg	$1175
Bernoulli 40 meg	$1720
Teac AT 1.2 Meg Drive	$100
XT ½ Height Drive	$85
SEAGATE 20 meg w/Western I/O	$309
Other Models	Call

256 Memory, One 360K Brand Name Floppy Drive • 135 Watt Power Supply, Slide Case, AT Style Keyboard • 4-10 MHz Clock Speed, (Keyboard Selectable), 8 Expansion Slots

Turbo PC/XT w/640K & 1 Drive	$415
Turbo PC/XT w/640K & 2 Drives	$485
Turbo PC/XT w/640K, 1 Drive & 20 MG	$725
PC/AT 10 MHz w/512K, 1.2 Floppy Drive	$935
PC/AT 10 MHz w/1024K, 1.2 Floppy Drive	$989
PC/AT 10 MHz w/1024K, 1.2 Floppy, 40 MG	$1519
MonGraphics Card with Parallel Printer Port	$69
Color Card w/Parallel Printer Port	$65
Amber Monitor (TTL)	$89
Amber Monitor w/Swivel Tilt	$99
Color Monitor (RGB)	$279
EGA+ Card	$145
I/O Card (Serial/Parallel)	$38
I/O Card (Serial/Clock Calendar)	$39
Enhanced Keyboard	$69
AT Multi I/O Card	$69
XT Multi I/O Card	$55

BOARDS

AST Six-Pack Plus	$115
Other Models	Call
ATI EGA Wonder	$245
CSSL Awesome	$375
Hercules Color Card	$145
Graphic Card	$175
Graphic Card +	$185
Intel Above Board PC 1010	$210
Above Board PS/PC (1110)	$239
Above Board AT (4020)	$315
Above Board PS/AT (4120)	$345
NEC Multisync Graphic Board	Call
Orchid Tiny Turbo 286	$355
Turbo EGA	$449
Paradise Five Pak	$99
Autoswitch 350	$205
Autoswitch 480	$279
Plus Development	
Plus Hard Card 20 Megabyte	$545
Plus Hard Card 40 Megabyte	$829
Quadram Quad EGA+	$265
Tec Mar Graphics Master	$409
Captain No Memory	$109
EGA Master	$239
Video-7 Vega Deluxe	$285

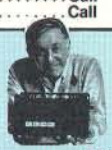
COMPUTERS

TOSHIBA

T-1100 Supertwist	Call
T-3100	Call

COPIERS

Canon (PC)



Canon PC-25 ..... $835

SOFTWARE

IBM PC and 100% Compatibles

TRAINING

Flight Simulator	$27
PC Logo	$69
Typing Instructor	$27
Typing Tutor III	$27
MS Learning DOS	$27

LANGUAGES

C Compiler (Microsoft)	$249
Fortran Compiler (Microsoft)	$245
Macro Assembler (Microsoft)	$83
Pascal Compiler (Microsoft)	$165
Quick Basic 2	$55
Turbo Jumbo Pack	$159
Turbo Pascal w/8087 & BCD	$55
Turbo C	$55
Turbo Basic	$55
Turbo Prolog	$54

PROJECT MANAGEMENT

Harvard Total Project Manager II	$282
Microsoft Project	$218
Super Project Plus	Call
Timeline 2.0	$235

COMMUNICATIONS

CompuServe Starter Kit	$19
Crosstalk XVI	$88
MS Access	$137
Mirror II	$33
Remote	$88
Smartcom III	$155

INTEGRATIVE SOFTWARE

Enable 2.0	$359
Framework II	$395
Smart Software System 3.1	$409
Symphony	$439
Ability	$55

GRAPHICS

Logi Mouse	Call
Logi Buss Mouse w/paint	$85
Newsmaster	$48
In-A-Vision	$259
Microsoft Buss Mouse 6.0	$103
Microsoft Chart 3.0	$249
Microsoft Serial Mouse 6.0	$115
Newsroom	$31
PC Buss Plus Mouse	$99
PFS: First Publisher	$45
IMSI Mouse w/Dr. Halo II	$92
PC Mouse	$89
Printmaster	$29
Signmaster	Call
Turbo Graphix Tool Box	$38

WORD PROCESSORS

Word Perfect Executive	$103
Leading Edge W/P w/Spell & Mail	$59
Turbo Lightening	$55
Microsoft Word 3.11	$175
Multimate Advantage II	$245
Wordstar w/Tutor	$162
Wordstar Pro Pack 4.0	$209
PFS: Professional Write	$89

Word Perfect (Ver.4.2)$195
Wordstar 2000 + 2.0 $205

SPREADSHEETS

Lotus 1-2-3	Call
Multiplan 3.0	$108
Twin	$35
VP Planner	$47

Supercalc 4 ..... Call

MONEY MANAGEMENT

Dollars & Sense w/Forcast	$92
Tobias Managing Your Money	Call

UTILITIES

MS Windows	$55
Copy II PC	$19
1 DIR Plus	$46
Fastback	$80
Norton Utilities 4.0	$48
Printworks	$36
Sidekick (Unprotected)	$47
Sideways 3.1	$37
Superkey	Call
Xtree	$25
SQZ	$46
Brooklyn Bridge	$72

DATA BASE MANAGEMENT

Clipper	$375
Cornerstone	$53
dBase II	$289
dBase III Plus	$379
Extended Report Writer	$175
Knowledgeman II PromoPack	$319
Quickcode Plus	$138
QuickReport	$138
Reflex	$79
DB-XL	$82
PFS: Professional File	$112

R:Base 5000 System V $415

Many other titles available.

CWF-887

Circle 65 on Reader Service Card for MS DOS Products.
(All others: 66)

COMPUTER WAREHOUSE

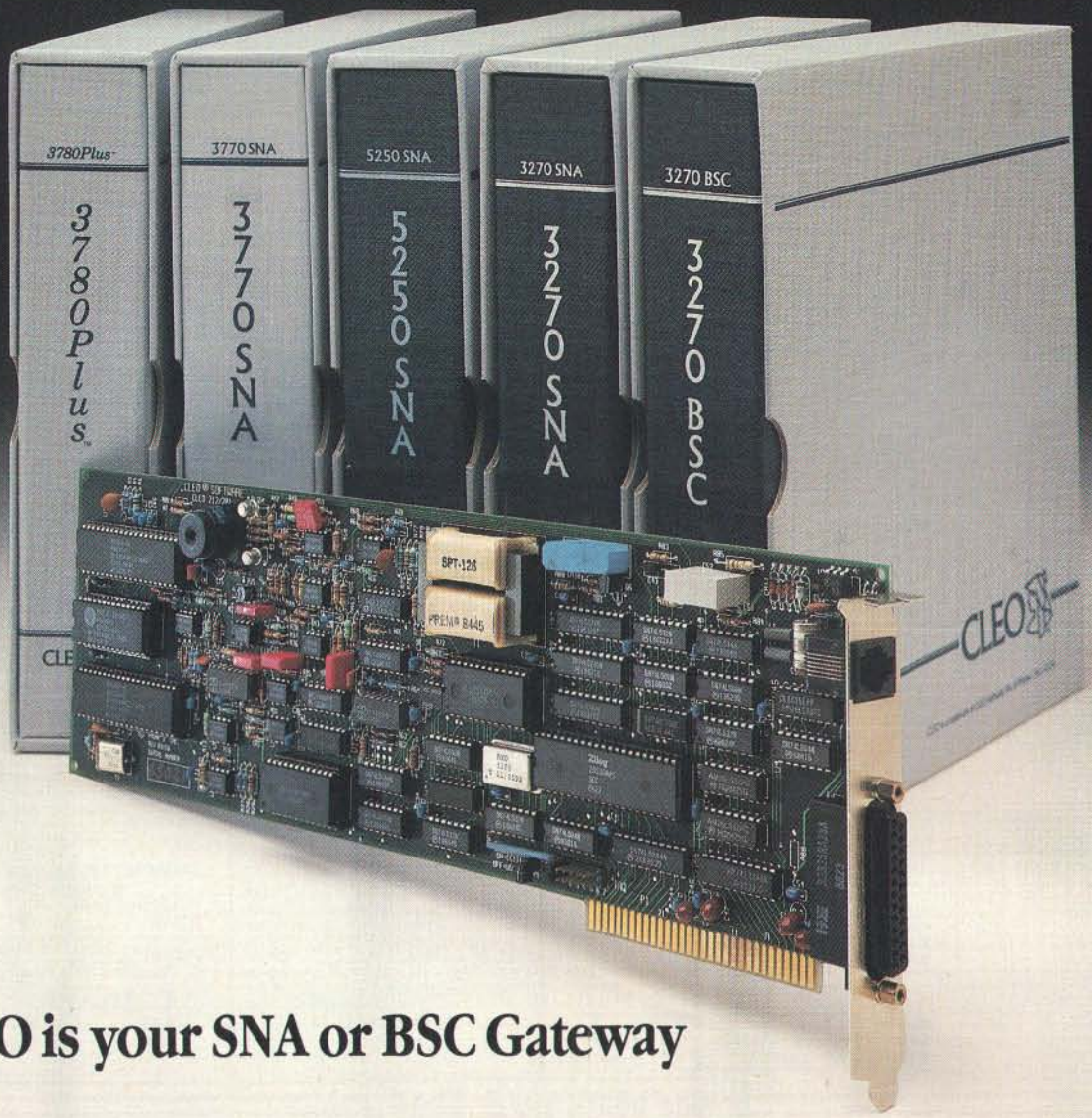
To Place an Order: 1-800-528-1054
To Follow-up on an Order: 602-944-1037

8804 N. 23rd Ave.
Phoenix, Arizona 85021

Order Line Hours:
Mon-Fri 7:00 a.m.-6:00 p.m.
Saturday 9:00-1:00
Order Processing:
10:00 a.m.-3:00 p.m. Mon-Fri

• No Charge for VISA and MasterCard • You Pay the Ground Shipping—We Pay the Air • Ground Shipping & Handling $6.00 • Free Air applies ONLY to orders up to 10 lbs. & Over $50. • All products carry a manufacturer's warranty. All Guarantees, rebates, trial period privileges & promotional programs are handled by the manufacturer only. • NO APO, FPO, or international orders, please • Call before submitting PO Numbers • Personal and Company Checks Will Delay Shipping 3 weeks • Prices, Terms & Availability Subject to Change Without Notice • Add 5% for COD Orders • We Do Not Guarantee Machine Compatibility

VISA MasterCard AMERICAN EXPRESS



CLEO is your SNA or BSC Gateway

Remote Sites Communication

Whatever your industry, your remote computers need to share information with your mainframe. Or, they need to exchange data with other remotes. In either case, you need a total solution at the remote sites. You need software, hardware interfaces and modems that all work together smoothly. You need CLEO!

CLEO software products allow microcomputers to communicate with minicomputers and mainframes, and to emulate their workstations. Since 1981, CLEO has provided remote communications between micros and mainframes for the automotive, insurance, medical and banking industries. Today over 44,000 CLEO users worldwide are running on all major brands of microprocessors. The greatest number of these users run CLEO software on IBM Personal Computers and NETBIOS LANs.

Complete Software/Hardware Package

Every CLEO package contains all the software and hardware accessories needed at the remote site. Your selected CLEO SNA or BSC software is packaged with 1) an internal modem card for dial-up applications, or 2) an interface card and cable for use with your existing modem. There's no waiting for non-CLEO add-ons. And, you get prompt, single-source service.

Package prices range from $795.00 for most stand-alone packages, up to $2,995.00 for the 32-user SNA gateway.

Call us today to discuss your application.

CLEO Software
1639 North Alpine Rd.
Rockford, IL 61107
Telex 703639

Headquarters:
USA: **1-800/233-2536**
Illinois: 1-800/422-2536
International: 815/397-8110

Sales and Distribution:
Benelux, Scandinavia: 31 (71) 899202
Canada, East: 800/361-3185
Canada, West: 800/361-1210
Canada, Montreal: 514/737-3631
Colombia, S.A.: 12875492
Denmark: 451 628300
Italy: (0331) 634 562
Mexico City: 203-0444

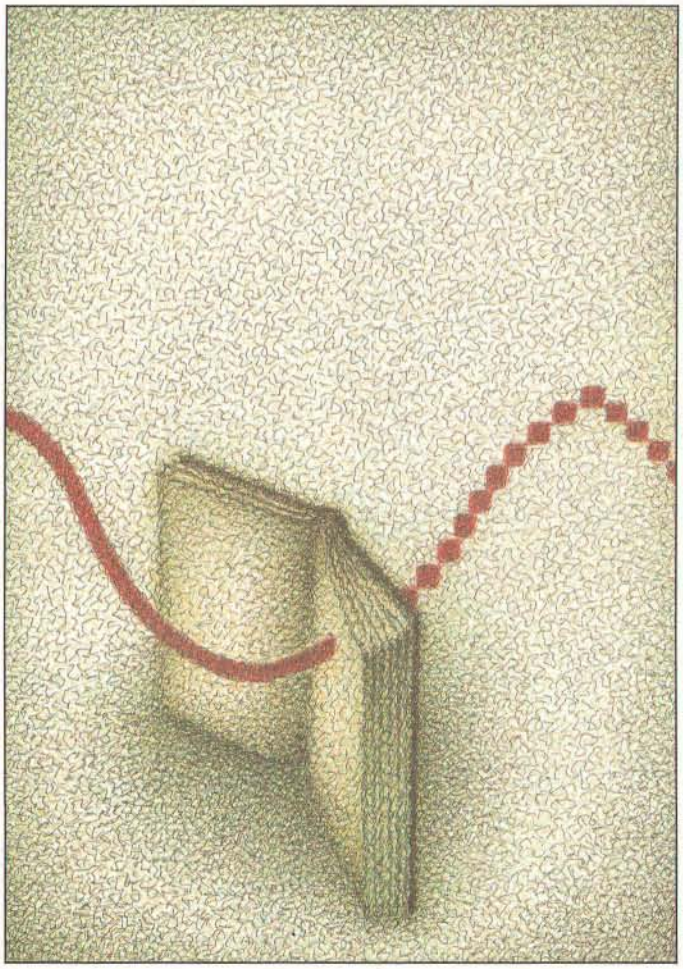
CLEO®

BOOK REVIEWS

LESSONS IN DIGITAL ESTIMATION THEORY
Jerry M. Mendel
Prentice-Hall
Englewood Cliffs, NJ: 1987
ISBN 0-13-530809-7
304 pages, $41.95

THE SOCIETY OF MIND
Marvin Minsky
Simon and Schuster
New York: 1987
ISBN 0-671-60740-5
339 pages, $21.95

THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE: LISTENING FOR LIFE IN THE COSMOS
Thomas R. McDonough
John Wiley & Sons
New York: 1987
ISBN 0-471-84684-8
244 pages, $19.95



LESSONS IN DIGITAL ESTIMATION THEORY

Reviewed by John V. Olson

Jerry M. Mendel's book is a concise, lucid, and intensely mathematical description of the current state of estimation theory and its extensions. *Lessons in Digital Estimation Theory*, the latest volume in the Prentice-Hall series on signal processing edited by Alan V. Oppenheim, is intended as an introductory text for a one-semester course in estimation theory.

The text is divided into 27 short "lessons," self-contained kernels that express and develop briefly a fundamental idea in estimation theory. Each lesson contains a few problems that are intended to allow the student to flesh out the mathematics and try the techniques presented. The author emphasizes digital implementation of the techniques described, which fits the modern approach to the analysis of signals and systems. Also, as Mendel points out, the mathematics associated with digital estimation theory are simpler than those associated with continuous estimation theory.

Roots of Parameter Estimation

The general task of estimation theory, as practiced in many fields in engineering and science, is to determine one or more of the parameters in a model that describes a physical process. The theory has its roots in Gauss's least-squares approach to the determination of the orbital elements of asteroids from measurements that contain errors. It has continued to be developed—driven, as Mendel points out, by the needs of technology.

The rise of digital technology has seen the concomitant rise in the number and variety of digital algorithms in digital estimation. The field was extended greatly in this century by the work of Wiener and Kalman in developing a least-squares approach to filters. Mendel has chosen to present the techniques of estimation theory in a digital format.

How Mendel Sees It

Mendel views the generalized extensions of the problem of least-squares parameter estimation as a natural extension of digital filter theory. Traditional filter design is concerned with fixed responses to deterministic signals and results in low-pass, band-pass, and high-pass filters that meet certain design criteria in the frequency band. Estimation theory, as Mendel points out, leads naturally to filters that have time-varying parameters.

The Four Steps

To begin the process of parameter estimation, you must perform the most difficult task: the proper description of a model to represent the signal or process at hand. Mendel identifies four steps in the modeling of a physical process: representation, measurement, estimation, and validation. The representation problem involves choosing an appropriate model for a system, here taken to be a mathematical model of the parameters of a system.

Once the system has been modeled, a series of physical quantities must be measured; these can be used to validate the model. It is the task of estimation theory to determine the values of the parameters of the model, including those that cannot be measured directly. Finally, validation of the model is performed using statistical measures of the confidence limits of the estimated model parameters.

Linear to Nonlinear

The bulk of this book deals with the problem of parameter estimation using linear models. In a linear model, the measurements are assumed to have a linear dependence on the parameters of the model and to be contaminated by an additive noise

continued

Illustration by Dave Ridley

field. When the parameters to be estimated can be assembled into a vector that describes the model, then the estimation of the state vector follows naturally from the ideas of parameter estimation.

Mendel provides this unification in a natural way, and it is one of the book's strong points. He ends with several lessons that extend the treatment to nonlinear systems. Most physical systems are described by nonlinear differential equations, and Mendel shows how such equations can be linearized and subjected to the techniques of linear parameter estimation.

A Coherent View

Within this framework, the author examines several important techniques of parameter-estimation theory. By beginning the book with a review of least-squares estimation techniques, he applies them to cases involving both large and small samples. The maximum-likelihood and maximum a posteriori methods are presented along with the best linear unbiased estimator (BLUE). Mendel then moves on to a study of state estimation. He covers the basic state-variable model and includes several examples. Finally, he examines the connection to least-squares theory and discusses the relationship between the Wiener and Kalman filters. Regarding nonlinear problems, Mendel focuses primarily on the treatment of the extended Kalman filter. He concludes with a discussion of the continuous-time Kalman-Bucy filter.

The appendix includes a glossary of major results. This listing lets students trace the logical development of the text, as well as find a particular theorem. Again, it shows the author's effort to bring a coherent view to what have been separate topics in estimation theory.

Classroom Experience

Lessons in Digital Estimation Theory is an excellent book, and I highly recommend it to those who are seeking a first contact with the mathematical foundations of estimation theory. The development of the material begins from a familiar foundation in least-squares theory and moves logically through the modern extensions, always with an eye to their relationship to the original least-squares approach. This well-integrated approach provides a coherent view of the state of estimation theory and its mathematical description.

Mendel states that the book is the outgrowth of a course he has given at the University of Southern California since 1978. The clarity of the ideas presented shows that the book has gone through the tempering process that occurs when a set of ideas is presented frequently in the classroom.

A Welcome Change

Mendel's approach is a welcome change from the current spate of "cookbooks" providing recipes and algorithms. Those may be useful as guides, but the study of the formulation of methods is a more helpful approach. If there is a weakness in *Lessons in Digital Estimation Theory*, it lies in the absence of discussions of the relative strengths and weaknesses of the methods. However, the author includes a few numerical examples for the student, and some of the exercises make use of these examples.

Students using this book must be well-grounded in the mathematics of signal processing. Although the author suggests that the text could be used for self-study, its compact, essentially mathematical presentation makes it more appropriate as a text for a course following a senior-level course in signal processing.

John V. Olson is an associate professor of geophysics (Geophysical Institute, University of Alaska, Fairbanks, AK 99701), a consultant, and a software developer.

continued

24 Hours A Day, 7 Days A Week

SOFTLINE NEVER SLEEPS

FOR THE BEST BUYS, CALL US ANYTIME.

Software

Word Processing/ Desktop Publishing

Fancy Font	$ 139
Microsoft Word	$ 209
Multimate Advantage-II	$ 259
Lotus Manuscript	$ 339
Office Writer /Speller	$ 249
Pagemaker	$ 489
PFS: Prof Write	$ 119
Ventura Publisher	$ 519
Volkswriter 3	$ 145
Word Perfect 4.2	$ 195
Word Perfect Server	$ 309
Word Perfect Station	$ 75
Wordstar Pro 4.0	$ 235
Wordstar 2000 +	$ 219
Xywrite III	$ 199
Xywrite III +	$ 249

Database Systems

Clipper	$ 389
DBase III Plus	$ 389
DBase III Lan Pak	$ 599
Foxbase +	$ 229
Paradox 2	$ 429
PFS: Prof File	$ 145
Q&A	$ 209
Quicksilver	$ 319
R Base System V	$ 449
RapidFile	$ 239
Reflex	$ 89
Revelation	$ 499

Spreadsheets/ Integrated Packages

Enable 2.0	$ 389
Framework II	$ 399
Javelin +	$ 179
Lotus 1-2-3	$ 309
Lotus Hal	$ 105
Multiplan	$ 125
Plan Perfect	$ 179
Smart System	$ 429
SuperCalc 4	$ 279
Symphony	$ 499

Communications

Carbon Copy +	$ 119
Crosstalk XVI	$ 95
Crosstalk Mark IV	$ 125
Relay Gold	$ 139
Smarterm (Persoft)	$ Call
Smartcom III	$ 149

Statistics

SPSS/PC +	$ 699
Statgraphics	$ 419
Systat	$ 439

Graphics

Chartmaster	$ 209
Diagraph	$ 279
Diagram Master	$ 189
Freelance Plus	$ 339
Graphwriter Combo	$ 349
Harvard Presentation Graphics	$ 239
MS Chart	$ 189
PC Paintbrush Plus	$ 99
Picture Perfect	$ 209
Presentation Pak	$ 329
Prodesign II	$ 149
Publishers Paintbrush	$ 169
Signmaster	$ 139

Desktop Environments

Lotus Metro	$ 65
MS Windows	$ 65
Sidekick	$ 59

Project Management

Harvard Total Project Manager II	$ 359
Microsoft Project	$ 249
Superproject Plus	$ 299
Timeline 2.0	$ 249

Languages/Utilities

Fastback	$ 89
Lattice C	$ 229
Norton Advanced	$ 79
Microsoft C	$ 279
Mace Utilities	$ 65
MS Fortran 4.0	$ 279
Quick Basic	$ 65
Turbo Basic	$ 59
Turbo C	$ 59
Turbo Pascal	$ 69

Productivity Tools

VP Expert	$ 59
Eureka	$ 119
Sideways	$ 39

Accounting

BPI	$ 179
Great Plains	$ 499

Easy Business $ 359
QUALIFIED INSTALLERS AVAILABLE

Hardware*

Computers

AST Premium 286	$ Call
Wyse 286 PC	$ Call
Panasonic Business Partner	$ Call
Toshiba 3100/1100 +	$ Call

Multifunction Boards

AST Advantage (128K)	$ 319
AST Advantage Premium	$ 419
AST 6 Pak Plus (64K)	$ 119
AST Premium (256K)	$ 219
AST Rampage PC	$ 219
AST Rampage 286	$ 399
Inboard 386AT	$1350
Intel AboveBoard	$ Call
PC Turbo 286 (1MB)	$ 749
QuadBoard (0K)	$ 109

Display Boards

ATI EGA Wonder +	$ 239
Hercules Graphics Card Plus	$ 189
Hercules Color Card	$ 159
Hercules In-Color	$ 309
NEC GB1	$ 359
Paradise Auto Switch EGA 480	$ 399
Quad EGA Prosync	$ 339
Qyadram EGA +	$ 289

Modems

Hayes 1200	$ 299
Hayes 1200B	$ 299
Hayes 2400	$ 449
Hayes 2400B	$ 449
Migent Pocket	$ 159
US Robotics 1200	$ 139
US Robotics 1200B	$ 109
US Robotics 2400B	$ 189
Ventel 2400	$ 399
Ventel 2400B	$ 399
Watson	$ 339

Emulation Boards

AST 5211-11 +	$ 629
Irma/2	$ 725

Monitors

Amdek 310A	$ 149
Amdek 410A	$ 169
Amdek 1280	$ 779
NEC MultiSync	$ 579
Princeton HX-12	$ 439
Princeton MAX-12E	$ 149

Printers/Plotters

Epson EX-1000	$ 549
Epson FX-286E	$ 449
Epson LQ-1000 w/Tractor	$ 599
HP 7475A	$1499
HP Laserjet II	$1825
NEC 3550	$ 789
Okidata 192 +	$ 359
Okidata 193 +	$ 519
Toshiba P321SL	$ 549
Toshiba P341SL	$ 749
Toshiba P351M2	$ 999

Mass Storage/Backup

Imega 20 + 20 W/intfc	$1949
Irwin Tape Drives	$ Call
Plus HardCard 20MB	$ 675
Plus HardCard 40	$ 929
Seagate ST 225 W/int	$ 329
Seagate ST238 W/int	$ 389
Tallgrass	$ Call
Tecmar QT60 Int	$ 899

Input Devices

Keytronics KB 101	$ 119
Microsoft Mouse	$ 129

Accessories

Curtis Ruby	$ 59
DataShield S-100	$ 69
Logical Connection	$ 329
Masterpiece Plus	$ 129
256K Ram Set	$ 39
8087 Math Chip	$ 119
80287 Math Chip	$ 189

3.5 INCH SOFTWARE NOW IN STOCK CALL!!

24 Hours A Day, 7 Days A Week

1-800-221-1260

Softline

Customer Service Hours: 9 AM—5 PM, Mon.—Fri.
In New York State call (718) 438-6057

MasterCard VISA

FREE SHIPPING
on all orders over $1,000.00, credit card orders and prepaid orders.

P.O. Box 300729,
Brooklyn, NY 11230
TELEX: 627-30170 or 910-240-3918
FAX: 718-972-8346

Our Policy:
• All returns require prior authorization • Visa or Mastercharge—add 3% • Cash, M.O. or bank check only—add $5.00 per order • Prepaid personal or company check—allow two weeks to clear

THE SOCIETY OF MIND

Reviewed by Darrow Kirkpatrick

Marvin Minsky's *The Society of Mind* says more sensible things about how people think than anything else I've read. Minsky has spent years contemplating thinking. He is fascinated by the minds of children, by the simplest and most complex mental problems, and by the challenge of programming computers to think like people. This book is a picture of how his ideas about thinking go together.

Even though the book will be read and studied by those at the cutting edge of psychology and artificial intelligence, Minsky doesn't see his book as scientific scholarship. He wants it to be read as an "adventure story for the imagination." He admits to making hundreds of assumptions and speculations, saying,

> Until we have a more coherent framework for psychology, it will remain too early for the task of weeding out unproved hypotheses or for trying to show that one theory is better than another—since none of our present-day theories seem likely to survive very long in any case. Before we can have an image of the forest of psychology, we'll have to imagine more of its trees and restrain ourselves from simplifying them to death.

The Sum of Small Ideas

The Society of Mind is intentionally unfocused. At the start, Minsky tells the reader that neither thinking nor theories about thinking can be very organized. Evolution has made our minds powerful by using countless, messy cross-connections—and Minsky doesn't quarrel with evolution. He groups his discussions into bite-size sections of one page each, spread across 31 chapters. Fortunately, the excellent glossary and index make the book's tangled web of thoughts easily accessible. Like its subject, the human mind, this book is a society of many small ideas. Minsky believes that when we join enough of these small ideas, we can explain the strangest of mysteries.

The Society of Mind is about psychology, not computer science. Don't read it for explicit directions on how to implement AI on your computer. Those of us in the small-computer world might be disappointed that Minsky barely mentions computer software and hardware, but he does mention AI more and more as the book progresses. I think he wants us to know where many of his ideas were born and where many of them have been tested by experience.

Rereading the Script

Connecting Minsky's ideas with the programming structures and algorithms they grew from is a task left to the reader. I often found myself "reverse-engineering" his conclusions about thinking—back to the computer problems that must have created them.

For example, Minsky says that you learn skills by experimenting to find which agents to use, then preparing a script that will do the job automatically. Later, when you need to solve the same type of problem, you unconsciously play back the script. This sounds like what I do with my favorite macro language when I want to automate a sequence of tedious computer commands. Minsky goes on to say that such a script would be limited if it could work on only one type of thing. Then he describes an "action" script that never refers to the thing it acts on, only to a temporary memory that represents the thing. To me this sounds like the standard structured programming practice of passing generic variables to subroutines.

Throughout the book, Minsky dwells on a few simple

continued

YOUR PC WANTS YOU TO GIVE IT THE SAME ADVANTAGE YOU GIVE YOUR TAPE DECK AND VCR.

It's only fair. Not to mention logical. PC's want to perform as well as all your other sophisticated electronic equipment. If you're like millions of informed people throughout the world, you rely on the ultimate in audio and video recording performance. You rely on TDK.

Well, you should also rely on TDK when it comes to your computer. TDK's Floppy Disks provide the same consistently high performance. The same level of absolute quality. Which is understandable since all TDK products share an unparalleled level of technical superiority that spans over 50 years. In fact, TDK is the world's largest manufacturer of magnetic media.

What's more, they're also a major producer of electronic component parts, including the most sophisticated heads for disk drives. What a strategic advantage! With vital "inside" information like that, it's no wonder their disks provide error-free performance.

So, if you want to put a smile on your computer's face, choose from TDK's family of 5.25-inch standard, 5.25-inch High Density and 3.5-inch No-Risk™ Disks. It's to you and your PC's advantage.

TDK®

THE NO-RISK™ DISK.

Northeastern Region: 516-625-0100; Southern Region: 404-948-1346; Midwestern Region: 312-676-5356; Western Region: 714-863-1844

example problems to illustrate his ideas. His Block-Arch and Hand-Change scenario concerns a child playing with blocks and a toy car. The child builds an arch-shaped structure, then notices a strange phenomenon: When you push the car through the arch, your arm gets trapped. Minsky goes on to use this simple situation to explore ideas about how we represent and recognize shapes, how we model space and the relationship of our bodies to it, and how we learn.

You Are Your Agents

Agents are crucial to Minsky's mind society. *Agent* is the term he uses to describe an element of the mind responsible for one thinking function. The majority of agents are just middle-level bureaucrats that manage the activities of agents below them and respond to requests from agents above. You would not be tempted to call the activity of any one agent "intelligent." Yet Minsky believes that when taken together as societies of processes, the mind's agents create emotions, the sense of self, and all the other facets of a human personality. The mind's intelligence emerges from its unintelligent agents.

Memory and Experience

Some of Minsky's most interesting thinking concerns how memory works. Most of us have wondered how the brain stores information. We may have tried picturing a vast reservoir of facts. Yet how could the brain possibly capture reality in a sea of static facts? And how it could retrieve useful information from that sea?

Minsky suggests that the brain does not try to store away facts. It contains special agents he calls *K-lines*, which can make records of what some agents are doing at a certain moment. Later, if you activate those K-lines, they restore those agents to their previous states. Thus, K-lines take a partial "snapshot" of your brain state during a certain event. You remember previous mental events because parts of your brain are doing precisely what they did before, and other parts are reacting to those parts as though the same events are happening again.

How does the mind know to arouse so many appropriate memories so quickly, without arousing too many? According to Minsky, when we learn by attaching agents to K-lines, we don't attach them all with equal firmness—we make strong connections only at a certain level of detail, or "level band." Weaker connections at higher and lower levels are default assumptions that retreat when other agents challenge them. These default assumptions contain some of our most valuable commonsense knowledge: They tell us what is usual or typical.

Minsky says that older psychological theories are based on pieces of memory too small or too large to be practical. He proposes a compromise that has been effective in AI work: structures called *frames*, which represent what we've acquired from previous experience. We remember millions of stereotypical frames that represent everyday happenings, such as being in a certain kind of room. A frame is like a blank form with many empty boxes, called *terminals*, to be filled. To represent a specific situation, we fill in the terminals with more detail. Normally, terminals come with agents already attached, and these are the default assignments that make up level bands.

To explain his theory, Minsky invents an intimidating medley of terms. For example, a *polyneme* is a type of K-line that arouses different activities in different agencies by sending the same message to each. *Micronemes* are inner mental-context clues that shade the mind's activities. Pronoun-like devices called *pronomes* access whatever mental activities are in progress. Pronomes that can operate in several different realms at once are *paranomes*. An *isonome*, a sort of opposite to a polyneme, is an agent that has a uniform effect on different agencies.

continued

You don't have to be an Engineer to use CAD anymore!

We've made Computer Aided Design & Drafting so easy-to-use, affordable, and capable that now it's showing up virtually everywhere. In the office, on the job site, at school, and home.

Managers are using Generic CADD™ to generate reports, forms and flow charts. Tradespeople are using Generic CADD™ to make plans and change plans. Schools are using Generic CADD™ to change the way their students learn.

Professionals of all types now realize that Generic CADD™ gives the same kind of power over their drawing that spreadsheet programs gave them with numbers!

Generic CADD™ Just $99.95
Not copy protected.
60-day money back guarantee.

Productivity Modules:
DotPlot™
AutoDimensioning™
Drafting
Enhancements 1™ & 2™
AutoConvert™
Generic IGES™

To order, call toll free:
1-800-228-3601
or 206-885-5307
8763 148th N.E.
Redmond, WA 98052

Circle 110 on Reader Service Card (Dealers: 111)

Generic
SOFTWARE

Programmer's Paradise Gives You Superb Selection, Personal Service and Unbeatable Prices!

Welcome to Paradise. The microcomputer software source that caters to your programming needs. Discover the Many Advantages of Paradise...

- Lowest price guaranteed
- Latest versions
- Huge inventory, immediate shipment
- Knowledgeable sales staff
- Special orders
- 30-day money-back guarantee*

Corporate Buyers — Call for special discounts and benefits!

We'll Match Any Nationally Advertised Price

New Extended Hours: 9AM EST — 7PM EST

	LIST	OURS
386 SOFTWARE		
ADVANTAGE 386 C	895	805
ADVANTAGE 386	895	805
PC-MOS 386	CALL	CALL
PHARLAP 386|ASM/LINK	495	419
VM/386	195	CALL
386 MICROPORT COMPLETE SYSTEM	799	679
386 DOS/MERGE	345	295
386 SCO COMPLETE XENIX SYS V	1495	1195
ARTIFICIAL INTELLIGENCE		
ACTIVE PROLOG TUTOR	65	55
ARITY COMBO PACK	1095	979
ARITY PROLOG INTERPRETER	295	229
ARITY STANDARD PROLOG	95	79
CHALCEDONY PROLOG	100	89
GOLDEN COMMON LISP	495	CALL
GCL 286 DEVELOPER	1190	CALL
INSIGHT 2 +	485	379
IQCLISP	300	CALL
MICROSOFT LISP	250	155
PC SCHEME	95	85
PROLOG 86 PLUS	250	CALL
PROLOG PROFESSIONAL COMPILER	895	759
SMALLTALK V	99	85
TRANS LISP	95	CALL
TRANS LISP PLUS	195	CALL
TURBO PROLOG	100	65
TURBO PROLOG TOOLBOX	100	65
VP EXPERT	100	89
ASSEMBLERS/LINKERS		
ADVANTAGE DISASSEMBLER	295	265
ADVANTAGE LINK	395	359
ASMLIB	149	125
DR ASSEMBLER + TOOLS	200	179
MICROSOFT MACRO ASSEMBLER	150	95
PASM86	195	109
PLINK86PLUS	495	289
RELMS CROSS ASSEMBLERS	CALL	CALL
UNIWARE CROSS ASSEMBLERS	CALL	CALL
VISIBLE COMPUTER: 8088	80	65
VISIBLE COMPUTER 80286	100	89
BASIC		
BETTER BASIC	199	129
FINALLY!	99	89
FLASH-UP	89	79
INSIDE TRACK	65	55
MACH 2	75	59
MS QUICKBASIC	99	65
PEEKS & POKES	45	39
QBASE	89	79
QUICK-TOOLS	130	109
QUICKPAK	69	59
SCREEN SCULPTER	125	95
STAY-RES	95	75
STRUBAS	495	445
TRUE BASIC	100	69
TURBO BASIC	100	65
DATABASE TOOLBOX	100	65
EDITOR TOOLBOX	100	65
TELECOM TOOLBOX	100	65
C++		
ADVANTAGE C++	495	479
PFORCE ++	395	225
C COMPILERS		
AZTEC C-COMMERCIAL	499	CALL
AZTEC C-DEVELOPERS	299	CALL
C86PLUS	497	369
DATALIGHT C DEVELOPER KIT	99	75
DATALIGHT OPTIMUM-C	139	105
HIGH C	595	CALL
LATTICE C	500	265
LET'S C	75	55
MICROSOFT C	450	269
QUICK C	99	65
TURBO C	100	65
C INTERPRETERS		
C-TERP	300	229
INSTANT C	500	379
RUN/C	120	79
RUN/C PROFESSIONAL	250	155

	LIST	OURS
C LIBRARIES		
ASYNCH MANAGER	175	135
BASIC—C	175	129
C-FOOD SMORGASBORD	150	95
W/SOURCE CODE	300	179
C TOOLS PLUS	175	135
C UTILITY LIBRARY	185	119
C-XPERT	295	249
ESSENTIAL COMMUNICATIONS	185	125
COMMUNICATIONS PLUS	250	189
GREENLEAF FUNCTIONS	185	125
GREENLEAF COMM LIBRARY	185	125
GREENLEAF SAMPLER (TURBO C)	100	79
MULTI-C	149	135
PFORCE	295	225
THE HAMMER	195	129
TIMESLICER	295	265
W/SOURCE CODE	1000	CALL
TURBO C TOOLS	129	109
COBOL		
COBOLSPII	395	329
FPLIB	149	129
MICRO FOCUS COBOL PRODUCTS	CALL	CALL
MICROSOFT COBOL	700	439
MICROSOFT SORT	195	129
OPT-TECH SORT	149	115
REALCICS	995	785
REALIA COBOL	995	785
W/REALMENU	1145	899
RM/COBOL	950	759
RM/COBOL-85	1250	999
SCREENIO	400	CALL
SCREENPLAY	175	129

MACINTOSH PRODUCTS

APL*PLUS/PC	595	429
BASIC COMPILER	195	139
BASIC INTERPRETER	99	69
CHALCEDONY PROLOG	100	89
CONSULAIR MAC C (MAC II)	600	509
FORTRAN COMPILER	295	209
LIGHTSPEED C	175	125
LIGHTSPEED PASCAL	125	89
MAC C JR.	80	59
MAC PROLOG	395	335
MACTRAN 77	199	179
MASTERFORTH	350	315
MACNOSY V2	90	69
TURBO PASCAL	100	65
Z BASIC	90	69

	LIST	OURS
DBASE TOOLS		
CLIPPER	695	459
DBASE III PLUS	695	429
DBASE TOOLS FOR C	80	65
DBASE GRAPHICS FOR C	80	65
DBRIEF	95	85
DBC III	250	169
DBC III PLUS	750	595
DBXL	139	99
DBPOWERPAK III	100	89
DB/RA	200	179
DOCUMENTOR	295	249
FOXBASE PLUS	395	CALL
GENIFER	395	299
QUICKCODE III PLUS	295	239
QUICKSILVER	599	499
TOM RETTIG'S LIBRARY	100	79
UI PROGRAMMER	295	249
DEBUGGERS		
386 DEBUG	195	155
ADVANCED TRACE-86	175	119
BREAKOUT	125	89
CSD DEBUGGER	75	59
C-SPRITE	175	119
PERISCOPE I	345	289
PERISCOPE II	175	139
PERISCOPE II-X	145	105
PERISCOPE III 8 MHZ	995	825
PERISCOPE III 10 MHZ	1095	899

	LIST	OURS
PFIX 86 PLUS	395	225
SOFTPROBE II/TX	750	715
XVIEW86	60	49
DISK/DOS/KEYBOARD UTILITIES		
BACK-IT	100	89
BOOKMARK	100	79
COMMAND PLUS	80	69
FASTBACK	175	129
INTELLIGENT BACKUP	150	135
KEYWORKS ADVANCED	299	239
NORTON COMMANDER	75	55
NORTON UTILITIES	100	59
ADVANCED NORTON UTILITIES	150	89
PDISK	145	89
Q-DOS II	70	59
QUAID ANALYZER	99	89
TASKVIEW	80	59
FILE MANAGEMENT		
ASMTREE	395	339
BTRIEVE	245	185
XTRIEVE	245	185
REPORT OPTION	145	99
BTRIEVE/N	595	455
XTRIEVE/N	595	455
REPORT OPTION/N	345	269
C-TREE	395	315
R-TREE	295	239
C-TREE/R-TREE BUNDLE	650	519
DBC III	250	169
W/SOURCE CODE	500	359
DBC III PLUS	750	595
DBVISTA	195	129
FABS PLUS	195	169
INFORMIX ESGL/C	595	CALL
INFORMIX 4GL	995	CALL
INFORMIX SQL	795	CALL
PHACT MANAGER	249	219
EDITORS		
BRIEF	195	CALL
W/DBRIEF	275	CALL
CVUE W/SOURCE CODE	250	199
EDIX	195	155
EMACS	295	265
EPSILON	195	149
FIRSTIME (C)	295	229
KEDIT	125	99
PC/EDT	250	229
PC/VI	149	109
PMATEPRO	195	109
SPF/PC	195	145
VEDIT PLUS	185	129
XTC	99	79
FORTRAN COMPILERS		
LAHEY FORTRAN	477	CALL
LAHEY PERSONAL FORTRAN 77	95	89
MICROSOFT FORTRAN	450	269
RM/FORTRAN	595	399
WATFOR FORTRAN	375	335
FORTRAN 77	350	319
FORTRAN UTILITIES/LIBRARIES		
ACS TIME SERIES	495	389
DIAGRAM'ER	129	115
DOCUMENT'ER	129	115
DIFF-E-Q	495	445
FORTLIB	125	109
FORTRAN ADDENDA	165	139
FORTRAN ADDENDUM	95	85
GRAFLIB	175	169
GRAFMATICS	135	119
MATHPAC	495	445
NO LIMIT	129	115
PLOTMATICS	135	119
SSP/PC	350	269
GRAPHICS		
ADVANTAGE GRAPHICS (C)	250	225
ESSENTIAL GRAPHICS	250	185
GRAPHIC	350	285
GSS GRAPHIC		
DEVELOPMENT TOOLKIT	495	375
HALO	300	205

	LIST	OURS
HALO (5 MICROSOFT LANG.)	595	389
HALO TEN FONT PACK	100	79
METAWINDOW	195	159
METAWINDOW PLUS	275	229
TURBOWINDOW/C	95	79
TURBO HALO (FOR TURBO C)	100	79
LINT		
PC-LINT	139	99
PRE-C	295	155
MODULA-2		
FARBWARE MODULA-2	90	79
LOGITECH MODULA-2		
APPRENTICE PACKAGE	99	79
WIZARD PACKAGE	199	159
MAGIC TOOLKIT	99	79
WINDOW PACKAGE	49	39
ROM PACKAGE AND CROSS RUNTIME DEBUGGER	299	239
REPERTOIRE	89	75
OPERATING SYSTEMS		
MICROPORT:		
286 DOS MERGE	149	125
SYSTEM V/AT (COMPLETE)	549	475
RUNTIME SYSTEM	199	169
SOFTWARE DEVELOPMENT SYSTEM	249	209
TEXT PREPARATION SYSTEM	199	189
UNLIMITED LICENSE KIT	249	209
SCO:		
XENIX SYSTEM V (COMPLETE)	1295	995
DEVELOPMENT SYSTEM	595	499
OPERATING SYSTEM	595	499
TEXT PROCESSING PACKAGE	195	145
WENDIN:		
OPERATING SYSTEM TOOLBOX	99	79
PCVMS	99	79
PCNX	99	79
WENDIN-DOS	99	79
WENDIN-DOS APPLICATION	99	79
PASCAL COMPILERS		
ADVANTAGE 386 PASCAL	895	805
MARSHALL PASCAL	189	155
MISCROSOFT PASCAL	300	185
PASCAL-2	350	329
TURBO PASCAL	100	65
PROFESSIONAL PASCAL	595	CALL
TURBO PASCAL ADD-ONS		
ALICE	95	69
DOS/BIOS & MOUSE TOOLS	75	69
FIRSTIME	75	59
FLASH-UP	89	79
FLASH-UP TOOLBOX	49	45
GSI PASCAL DEBUGGER	50	45
INSIDE TRACK	65	55
MACH 2	75	59
METRABYTE DATA ACQ. TOOLS	100	89
PASCAL HELPER	80	75
PEEKS & POKES	45	39
SCIENCE AND ENGIN. TOOLS	75	69
SCREENPLAY	175	129
SCREEN SCULPTOR	125	95
SYSTEM BUILDER	150	129
IMPEX	100	89
REPORT BUILDER	130	115
TP2C	249	199
TURBO•ASM	99	69
TDEBUGPLUS	60	49
TURBO ASYNCH PLUS	100	79
TURBO EDITOR TOOLBOX	70	45
TURBOEXTENDER	85	65
TURBO GRAPHIX TOOLBOX	70	45
TURBOHALO	129	99
TURBOMAGIC	99	89
TURBO MASTER	125	99
TURBO NUMERICAL METHODS	100	65
TURBO OPTIMIZER	75	65
TURBO POWER TOOLS PLUS	100	79
TURBO PROFESSIONAL	70	49
TURBOPOWER UTILITIES	95	79
TURBOWINDOW/PASCAL	95	79
UNIVERSAL GRAPHICS LIBRARY	150	119

NEW PRODUCTS

PMATEPRO—Phoenix's fully customizable full screen editor now does file editing limited only by memory. And its unique text storage method allows movement of the cursor to the end of the file instantaneously. PMATEPRO includes support for user-definable overlapping windows, keyboard remapping, and FORTRAN and c-specific macros. List $195 **Ours: $109**

PHACT-MANAGER—An ISAM database record manager with over 2,000 licenses in the field, under DOS, VAX and UNIX systems. And now a tremendous bargain. Phact-Manager now includes Phact dbrm, query, report, and full "C" source code, yet lists at $249. **Ours: $219**

ADVANTAGE VCMS—A powerful version control management system needed for any ongoing software development project. ADVANTAGE VCMS maintains a complete revision history in data compressed files. A powerful report generator is provided for selective queries. The tools and utilities included can be accessed through an easy-to-use, full-screen menu-driven shell. Additionally, a make utility, designed to work together with ADVANTAGE VCMS is included. List: $379 **Ours: $329**

THE KORN SHELL—A direct part of The Popular UNIX System V KSH command line interpreter used throughout AT&T and Bell Laboratories. Some of the Korn Shell's features are built-in command line editing, command re-entry and command aliasing available for either XENIX or UNIX. List: $125 **Ours: $115**

PROFILERS		
CODESIFTER	119	85
PFINISH	395	225
THE PROFILER	125	89
THE WATCHER	60	55
SCREEN DISPLAY/WINDOWS		
C POWER WINDOWS	130	115
C-SCAPE	279	CALL
CURSES W/SOURCE CODE	250	169
FORMAKER	495	CALL
GREENLEAF DATA WINDOWS	225	155
W/SOURCE CODE	395	289
JAM	750	CALL
MICROSOFT WINDOWS	99	65
MS WINDOWS DEVELOPMENT KIT	500	309

	LIST	OURS
ANEL	295	199
ANEL PLUS	495	395
UICKSCREEN	195	175
ITAMIN C	225	165
C SCREEN	99	85
INDOWS FOR C	245	189
INDOWS FOR DATA	395	315
IEW MANAGER	275	199
VIEW	245	169
RANSLATORS		
AS___C (ECONOMY)	199	169
AS___C (COMMERCIAL)	375	319
AS___PAS (ECONOMY)	149	125
AS___PAS (COMMERCIAL)	280	239
ASTOC	495	399
ASTOC (BASICA VERSION)	795	639
B2C	299	CALL
BXTRANSLATOR	350	299
TRAL	179	CALL
TC PLUS	325	289
P2C	249	199
DDITIONAL LANGUAGES		
CTOR	495	419
PL * PLUS/PC	595	429
S/FORTH	395	359
ANUS/ADA C PACK	95	89
ATTICE RPG II COMPILER	750	629
SCREEN DESIGN AID	350	309
SOURCE ENTRY UTILITY	250	199
SORT/MERGE UTILITY	250	199
IASTER FORTH	125	115
C/FORTH	150	109
ERSONAL REXX	125	99
OCKET APL	95	79
HE WEINER SHELL	199	179
DDITIONAL PRODUCTS		
DVANTAGE VCMS	379	329
AN BRICKLIN'S DEMO PROGRAM	75	59
AN BRICKLIN'S DEMO TUTORIAL	50	45
AST FORWARD	70	59
LOW CHARTING II	229	205
ELP/CONTROL	125	99
INK & LOCATE	350	315
ORTON GUIDES	100	65
S CHARTS	450	405
N-LINE HELP	149	99
APIENS V8	300	269
ET: SCIL	349	319
OFTSCREEN HELP	195	149
OURCE PRINT	95	75
EXT MANAGEMENT UTILITIES	120	89
REE DIAGRAMER	77	69
ENTURA PUBLISHER	895	625
BLAISE		
SYNCH MANAGER	175	135
TOOLS PLUS	175	135
XEC PROGRAM CHAINER	95	75
LIGHT TOOLS FOR DATALIGHT C	100	79
PASCAL TOOLS	125	99
PSACAL TOOLS 2	100	79
PASCAL TOOLS & TOOLS 2	175	135
RUNOFF TEXT FORMATTER	50	45
TURBO ASYNCH PLUS	100	79
TURBO C TOOLS	129	99
TURBO POWER TOOLS PLUS	100	79
VIEW MANAGER	275	199
BORLAND		
EUREKA EQUATION SOLVER	100	65
REFLEX & REFLEX WORKSHOP	200	129
REFLEX DATA BASE SYSTEMS	150	89
REFLEX WORKSHOP	70	45
SIDEKICK & TRAVELING SIDEKICK	125	85
SIDEKICK	85	59
TRAVELING SIDEKICK	70	45
SUPERKEY	100	65
TURBO BASIC COMPILER	100	65
TURBO DATABASE TOOLBOX	100	65
TURBO EDITOR TOOLBOX	100	65
TURBO TELECOM TOOLBOX	100	65
TURBO C COMPILER	100	65
TURBO JUMBO PACK	300	219
TURBO LIGHTNING	100	65
TURBO PASCAL	100	65
TURBO PASCAL AND TUTOR	125	85
TURBO TUTOR	40	29
TURBO PASCAL NUMERICAL METHODS TOOLBOX	100	65
TURBO PASCAL DATABASE TOOLBOX	70	45
TURBO PASCAL EDITOR TOOLBOX	70	45
TURBO PASCAL GAMEWORKS TOOLBOX	70	45
TURBO PASCAL GRAPHICS TOOLBOX	70	45
TURBO PROLOG COMPILER	100	65
TURBO PROLOG TOOLBOX	100	65
WORD WIZARD	70	49
WORD WIZARD AND TURBO LIGHTNING	150	95
DIGITAL RESEARCH		
CB 86	600	539
PASCAL MT+	400	359
PL1___86	750	675
DR ASSEMBLER + TOOLS	200	179
ACCESS MANAGER	400	359
DISPLAY MANAGER	500	449
FORTRAN 77	350	319
LATTICE		
LATTICE C COMPILER	500	265
W/SOURCE CODE	900	495
C CROSS REFERENCE GENERATOR	50	39
W/SOURCE CODE	200	139
C-FOOD SMORGASBORD	150	95
W/SOURCE CODE	300	179
C-SPRITE	175	119
CURSES SCREEN MANAGER	125	89
W/SOURCE CODE	250	169
CVUE	75	59
W/SOURCE CODE	250	199
DBC III/II	250	169
W/SOURCE CODE	500	359
DBC III PLUS	750	595
W/SOURCE CODE	1500	1185
LMK	195	139
LSE	125	99
RPG II COMBO	1100	875
RPG II COMPILER	750	629
RPG II SEU	250	199
RPG II SORT/MERGE	250	199
RPG II SCREEN DESIGN AID	350	309
SECRETDISK	120	89
SIDETALK	120	89
SSP/PC	350	269
TEXT MANAGEMENT UTILITIES	120	89
TOPVIEW TOOLBASKET	250	179
W/SOURCE CODE	500	359
LIFEBOAT		
ADVANTAGE 386 C	895	805
ADVANTAGE 386 PASCAL	895	805
ADVANTAGE C++	495	479
ADVANTAGE DISASSEMBLER	295	265
ADVANTAGE GRAPHICS	250	225
ADVANTAGE LINK	395	359
ADVANTAGE MAKE	125	99
ADVANTAGE VCMS	379	329
PANEL	295	199
PANEL PLUS	495	395
QUICKSCREEN	195	175
RUN/C - THE C INTERPRETER	120	79
RUN/C PROFESSIONAL	250	155
TIMESLICER	295	265
W/SOURCE CODE	1000	895
MICROSOFT		
MS BASIC COMPILER (XENIX)	695	419
MS BASIC INTERPRETER (XENIX)	350	209
MS C COMPILER	450	269
MS COBOL COMPILER FOR XENIX	700	439
MS FORTRAN FOR XENIX	995	609
MS LEARNING DOS	450	269
MS LISP	695	419
MS MACRO ASSEMBLER	50	39
MS MOUSE BUS VERSION	250	155
MS MOUSE SERIAL VERSION	150	95
MS MUMATH	175	119
MS PASCAL COMPILER FOR XENIX	195	125
MS QUICK BASIC COMPILER	300	185
MS QUICK C	695	419
MS SORT	99	65
MS WINDOWS	195	125
MS WINDOWS DEVELOPMENT KIT	99	65
	500	309
PHOENIX		
PASM86	195	109
PDISK	145	89
PFANTASY PAC	995	599
PFINISH	395	225
PFIX86PLUS	395	225
PFORCE	395	225
PFORCE++	395	225
PLINK86PLUS	495	299
PLOCATE	CALL	CALL
PMAKER	125	79
PMATEPRO	195	109
PRE-C	295	155
PTEL	195	109
POLYTRON		
POLYBOOST	80	69
POLYDESK III	99	85
POLYDESK III ARCHIVIST	50	45
POLYDESK III CRYPTOGRAPHER	50	45
POLYDESK III TALK	70	59
POLYLIBRARIAN	99	85
POLYLIBRARIAN II	149	125
POLYMAKE	149	125
POLYSHELL	149	125
POLYTRON C BEAUTIFIER	49	45
POLYTRON C LIBRARY I	99	85
POLYXREF	219	189
POLYXREF ONE LANGUAGE	129	109
PVCS NETWORK	1000	CALL
PVCS CORPORATE	395	335
PVCS PERSONAL	149	125
PVMFM	199	155

XENIX/UNIX PRODUCTS

ADVANTAGE C++	695	CALL
BTRIEVE	595	455
C-TERP	498	379
INFORMIX	CALL	CALL
KORN SHELL	125	115
MICROSOFT LANGUAGES	CALL	CALL
PANEL PLUS	795	675
REAL TOOLS	149	89
RM/COBOL	1250	949
RM/FORTRAN	750	549

AMIGA PRODUCTS		
AZTEC COMMERCIAL	499	449
AZTEC DEVELOPERS	299	269
DBMAN	150	119
LATTICE AMIGA DOS COMPILER	225	179
LATTICE PRO AMIGA C COMPILER	375	299
MODULA II REG	90	75
MODULA II DEV	150	125
TRUE BASIC	100	79

Windows for Data

uild a state-of-the-art user interface into your user program. omplete system for building and managing menus, data-entry rms, user help and text files in a windowing environment. Begins here others end. Features include: Field entry from lists of hoices, scrollable regions for entry of a vari- ble number of line items, nesting and branch- g of forms and menus. Unique built-in ebugging system. **List $395 Ours $315**

Vermont Creative Software

Essential Communications Plus

C library plus debugger stressing reliability and ease of use. It nables speeds to 9600 baud with XON/XOFF and XMODEM upport. It includes a thorough manual with tutorial and easy-to- llow examples and demos. The debugger turns your PC into a ophisticated line monitor while an internal editor nables you to create, send or capture data, save to a file, compute checksums or edit it in Hex r ASCII. **List $250 Ours $189**

PforCe

PforCe is a pre-coded optimized object-oriented toolkit of over 400 outines for C programmers. It includes data bases with B-trees, indows, interrupt-driven communications, string handling, enus, all of the basic DOS interfaces, and a complete set of low- evel functions to interface directly to the hard- ware. PforCe comes complete with indexed refer- nce manual, on line resident help, and quick eference card. **List $295 Ours $225**

Phoenix

Periscope III

Periscope III sets a new standard in price/performance for real-time hardware breakpoint debuggers. You'll find the errors in real-time systems, stop intermittent failures, interface with undocumented systems and eliminate bottlenecks in your code. It's an easy transition from other models too, since the commands are a superset of those used in Periscope I, II and II-X. One board works on PC/XT/AT. Includes the board, break-out switch, software and quick reference card. **8MHZ List $995 Ours $899**

PERISCOPE

Microsoft Quick C

The New Quick C from Microsoft sets new standards for speed in a C Compiler. Fast and complete; compilation speed of 10,000 lines/min. Includes source-level debugger, graphics libraries, library manager, make facility. The libraries in Quick C support ANSI standard C and the UNIX System V standard for C. Quick C supports 8087/ 80287 math coprocessor. Quick C supports multiple module programming and dynamic break points. **List $99 Ours $65**

Microsoft

TimeSlicer New Version

A library of C functions to create multitasking and real-time programs at the application level rather than interfacing with the operating system. Create, suspend or terminate tasks at run-time. Compatible with Lattice C, Microsoft C, ADVANTAGE C++ and object-oriented programming. **List $295 Ours $265**

LIFEBOAT

Terms and Policies
- **We honor MC, VISA, AMERICAN EXPRESS**

No surcharge on credit card or C.O.D. Prepayment by check. New York State residents add applicable sales tax. Shipping and handling $3.00 per item, sent UPS ground. Rush service available, prevailing rates.
- Programmer's Paradise will match any current nationally advertised price for the products listed in this ad.
- Prices and Policies subject to change without notice.
- ***New* Extended Hours 9AM EST — 7PM EST**

*Ask for details. Some manufacturers will not allow returns once disk seals are broken.

Corporate Buyers — Call for special discounts and benefits!

1-800-445-7899
In NY: 914-332-4548
Customer Service: 914-332-0869
International Orders: 914-332-4548
Telex: 510-601-7602

Programmer's Paradise

42 River Street, Tarrytown, NY 10591

A Fresh Start

Minsky's ideas seem very close to the truth about how minds work. This makes them seem obvious, because on a superficial level we are all familiar with how the mind appears to work. However, the theoretical basis for these practical ideas is far from obvious.

For me, Minsky has made a fresh start on explaining the mind. His book doesn't take the little we know about brain hardware and try to force-fit a theory of mind onto the world of neurons, synapses, and brain chemistry. Instead, the book is a lively discussion of the brain's software. It takes cues from biology, child psychology, and computer science to build a model of how a thinking machine as powerful as the human brain might work.

Minsky says frightening things that may threaten our sense of self and our place in the universe. But he also has words of encouragement. He doesn't accept incompetence of intellect as a normal, if unfortunate, deficiency in talent. He thinks that intellectual incompetence should be treated as an illness to be cured, just as emotional and other human deficiencies are treated.

"Only" a Machine

For Minsky, the mind is a machine—a powerful, complex machine, but nevertheless a machine we can understand using scientific methods. He wonders why people are so distraught that our most prized possession, the mind, might be "only" a machine. For Minsky, machines are the most wonderful constructs on earth:

> Are minds machines? Of that, I've raised no doubt at all but have only asked, what kind of machines? And though most people still consider it degrading to be regarded as machines, I hope this book will make them entertain, instead, the thought of how wonderful it is to be machines with such marvelous powers.

Darrow Kirkpatrick (P.O. Box 376, Rosendale, NY 12472) is an engineer, consultant, and freelance technical writer.

THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE: LISTENING FOR LIFE IN THE COSMOS

Reviewed by Jack Kirwan

Philosophers from every culture wonder about the possibility of other life forms in the universe. But because there has been absolutely no data and no way of getting it, the possibility has never become more than idle speculation.

Thanks in large part to computers, all that is changing. Not only have the arguments for and against extraterrestrials become more sophisticated, so have the techniques of sending information. Addressing this topic is Thomas R. McDonough's interesting, very clear, but sometimes uneven survey, *The Search for Extraterrestrial Intelligence*.

McDonough, a lecturer at California Institute of Technology, is the coordinator for the Search for Extraterrestrial Intelligence (SETI) within the Planetary Society, so he brings to the book a definitive pro-SETI bias. This is not so bad, except for his chapter on the objections to SETI (which I'll discuss later). Unlike Edward Regis Jr.'s excellent anthology, *Extraterrestrials—Science and Alien Intelligence* (see my review in the August 1985 BYTE, page 62), McDonough's book is not an academic, highly technical treatment of the subject. It is popularly written, and, as Isaac Asimov and Ben Bova have demonstrated, popular writing is not necessarily unscientific. However, McDonough wants extraterrestrials to exist so much you can almost taste it.

continued

AW . . . WHAT THE HECK!

More than two years ago, we introduced the leading low-cost (under $1000) CAD system, ProDesign II. It was priced at $299. Since that time, more than 1000 enhancements have been added to the software, making ProDesign II the price performance leader in CAD.

Now, ProDesign II has been renamed DesignCAD and packaged with more than $400 worth of supplementary software, including symbol libraries, file transfer utilities, and materials list programs. We added more than 100 enhancements to the software, making DesignCAD an extremely powerful CAD system at any price.

We were at a loss, however, when it came time to set the price. We considered pricing DesignCAD at $999. We thought about reducing the price to a low $599. We talked to industry experts. We met with marketing consultants. We performed calculations on the finest spreadsheets money can buy. Then, in the great American tradition, we said "Aw . . . What the Heck!" DesignCAD is priced at $299!

New Name: ProDesign II is now DesignCAD

New Features:

- Compatibility with most other CAD systems large and small (DXF and IGES, Input and Output included at no extra charge).
- Compatibility with virtually all desktop publishing systems is included at no extra charge.
- Expanded Memory Support is now provided to utilize the full power of your PC/AT.
- Several new character fonts are now provided at no extra charge.
- More than 100 new drawing features are now provided at no extra charge.
- Symbol libraries with more than 500 symbols are included at no extra charge.
- A Bill of Materials utility is provided at no extra charge.
- DesignCAD provides complete support for the IBM System/2.

Same Quality:

- DesignCAD has all the features and capabilities of ProDesign II - normally found only in CAD systems costing thousands of dollars.
- DesignCAD, like ProDesign II, has unparalleled ease of use.
- DesignCAD, like ProDesign II, has unprecedented dot matrix print quality.
- DesignCAD supports more than 200 printers, 80 plotters, and virtually any mouse, digitizer, and display compatible with the IBM PC.

Call or write for a FREE DEMO DISK:

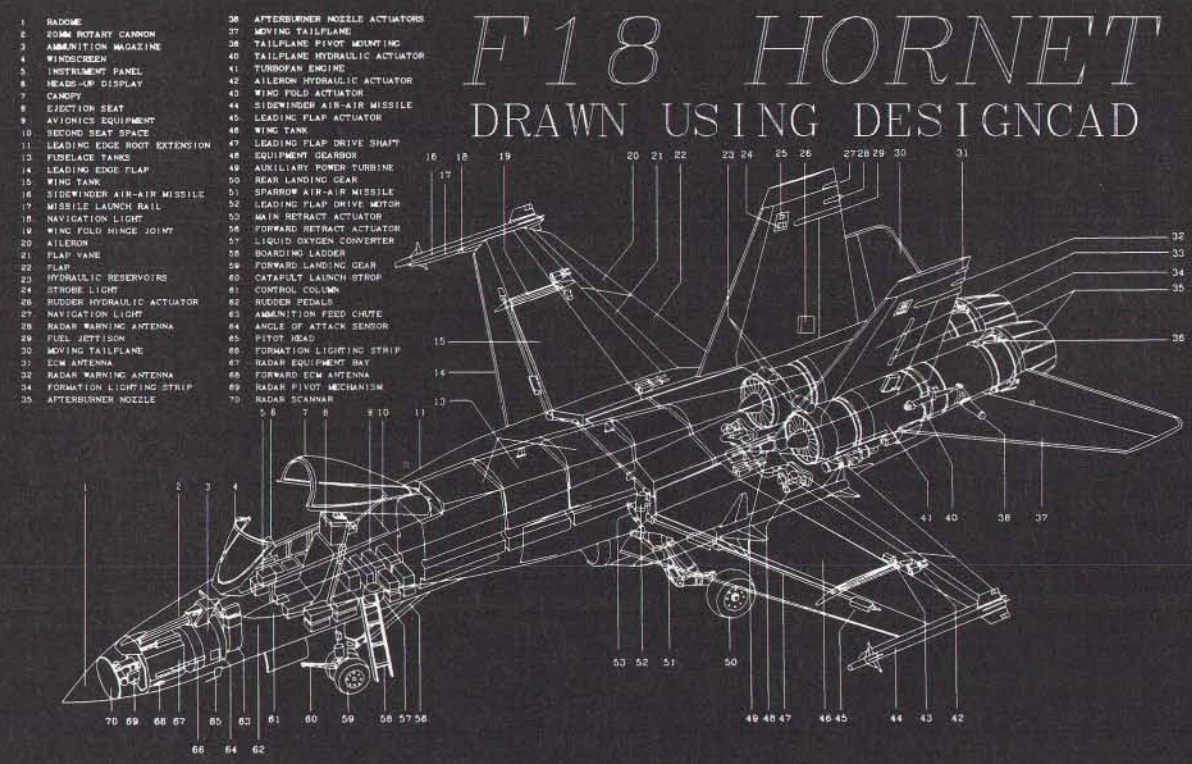
American Small Business Computers

118 South Mill • Pryor, OK 74361 • 918/825-4844

ProDesign II is now DesignCAD

Still Only **$299!**

Circle 15 on Reader Service Card



SETI's Earliest Beginnings

Despite centuries of philosophical and theological speculation, serious searching for extraterrestrial intelligence began in the 19th century. In the 1820s, mathematician Carl Friedrich Gauss proposed talking to lunar inhabitants by planting pine trees "in the shape of squares on the side of a right triangle." He hoped this would communicate to the extraterrestrials on the Moon that humans at least knew the Pythagorean theorem. Nothing came of this, nor of the Viennese astronomer Joseph von Littrow's idea of digging a 20-mile ditch in the Sahara, filling it with kerosene, and tossing in a lit match.

Mostly due to the American astronomer Percival Lowell, interest shifted from the Moon to Mars. Lowell was convinced (thanks to the work of Italian astronomer Giovanni Schiaparelli) that there was intelligent life on Mars. He wrote a series of scholarly books on the subject. In fact, as McDonough points out, the Martian extraterrestrial hypothesis became so widely accepted that "a contest was eventually held to reward the first discovery of intelligent life beyond Earth, excluding Mars—because that would be too easy."

Most of the confusion about Mars resulted from a simple mistranslation. When observing Mars, Schiaparelli had seen what appeared to be grooves or straight lines through his telescope. He labeled them "canali," the Italian word for channel. In the excitement, a linguistic jump mistranslated the word as "canal," thus implying a level of intelligent engineering.

The Modern SETI

The modern SETI began in 1959 with an article by Philip Morrison and Giuseppe Cocconi in the British journal *Nature*. Discounting the idea of other intelligent life in the solar system, they concluded that "the easiest way to communicate across the galaxy would be by radio signals." And with this, the story of SETI begins to pick up.

The first problem, of course, is which of many channels to tune into. Trying to cover all parts of the sky with every channel is a centuries-long, mind-boggling concept, so Morrison and Cocconi proposed using the fundamental radio signal that hydrogen atoms broadcast.

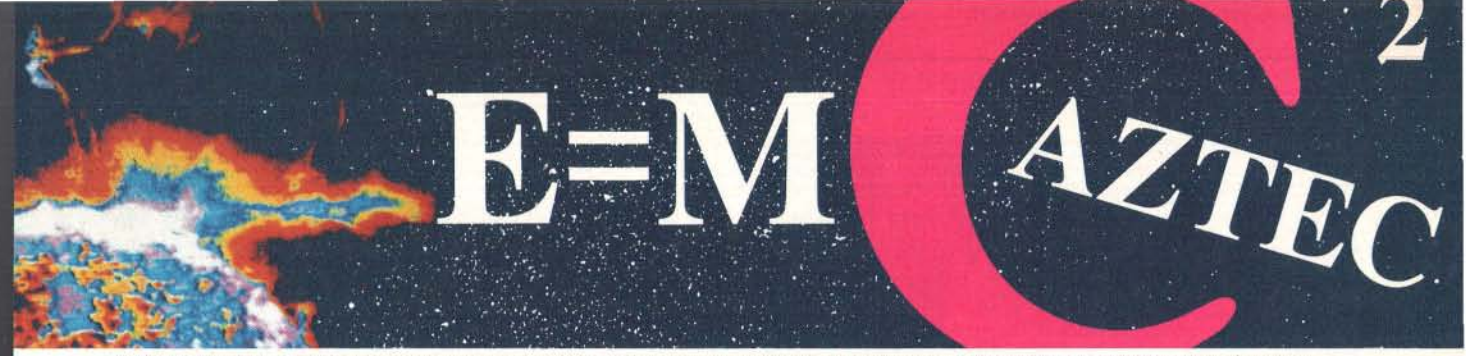
In McDonough's words, "over the vastness of space there are so many atoms that the feeble radio broadcasts of each one would add up to a detectable signal. The atoms broadcast at a frequency of 1420 megahertz." Morrison and Cocconi reasoned that if there are other civilizations in the universe, they would probably know about this hydrogen signal, so 1420 MHz would be the channel of choice.

Herein lies another major problem with SETI: trying to figure out what the members of a totally alien civilization would be like. Some simplistic judgments assume that extraterrestrials would follow certain positive terrestrial philosophical bents—often those of the assumers. Others think that any advanced civilization anywhere must share certain scientific basics (e.g., the speed of light and pi) and must go on from there to develop means of communication. But for the most part, putting together an intelligent and rational SETI package is a complicated and interesting tale, and the strongest part of McDonough's book.

The Drake Equation

Naturally, the biggest question in SETI is whether or not anybody is out there sending or receiving. Here we get an interesting professional breakdown. A lot of astronomers tend to be on the pro-extraterrestrial side, while many microbiologists are opposed. SETI pioneer Frank Drake, for example, set up seven questions (to form what's now labeled The Drake Equation) to argue for the defense. These questions (plus McDonough's estimated answers in parentheses) are as follows:

continued



Our thanks to NASA for supplying this computer enhanced ultraviolet photo taken by Skylab IV of a solar prominence reaching out 350,000 miles above the sun's surface

Genius Begins With A Great Idea ...

But The Idea Is Just The Beginning

What follows is the time consuming task of giving form and function to the idea.

That's why we concentrate on building into our software development systems functions and features that help you develop your software ideas in less time and with less effort.

We've started 1987 by releasing new versions of our MS-DOS, Macintosh, Amiga, ROM, and Apple // C development systems. Each system is packed with new features, impressive performance, and a little bit more genius.

FREE 2 DAY DELIVERY

Aztec C86 4.1

New PC/MS-DOS • CP/M-86 • ROM

Superior performance, a powerful new array of features and utilities, and pricing that is unmatched make the new Aztec C86 the first choice of serious software developers.

Aztec C86-p Professional System $199
• optimized C with near, far, huge, small, and large memory + Inline assembler + Inline 8087/80287 + ANSI support + Fast Float (32 bit) + optimization options • Manx Aztec 8086/80x86 macro assembler • Aztec overlay linker (large/small model) • source level debugger • object librarian • 3.x file sharing & locking • comprehensive libraries of UNIX, DOS, Screen, Graphics, and special run time routines.

Aztec C86-d Developer System $299
• includes all of Aztec C86-p • Unix utilities make, diff, grep • vi editor • 6 + memory models • Profiler.

Aztec C86-c Commercial System. $499
• includes all of Aztec C86-d • Source for library routines • ROM Support • CP/M-86 support • One year of updates.

Aztec C86 Third Party Software

A large array of support software is available for Aztec C86. Call or write for information. The following is a list of the most requested products: • Essential Graphics • C Utility Library • Curses • Greenleaf Communication, General, and Data Window • Halo • Panel + • PC-lint • PforCe • Pre-C • Windows for C • Windows for Data • C terp • db__Vista • db-Query • Phact • Plink-86 Plus • c-tree • r-tree • Pmate.

CP/M • TRS-80 • 8080/Z80 ROM

C compiler, 8080/Z80 assembler, linker, librarian, UNIX libraries, and specialized utilities.

Aztec C II-c (CP/M-80 & ROM). $349
Aztec CII-d (CP/M-80) $199
Aztec C80 (TRS-80 3&4) $199

Aztec C68k/Am 3.4

New Amiga Release

Amiga user groups across the USA voted Aztec C68k/Am release 3.3 the best Software Development System for the Amiga. Release 3.4 is more impressive.

Aztec C68k/Am-p Professional $199
A price/feature/performance miracle. System includes: optimized C • 68000/680x0 assembler • 68881 support • overlay linker • UNIX and Amiga libraries • examples.

Aztec C68k/Am-d Developer $299
The best of Manx, Amiga, and UNIX. System includes: all of Aztec C68k/Am-p • the Unix utilities make, diff, grep and vi.

Aztec C68k/Am-c Commercial. $499
Aztec C68k/Am-d plus source for the libraries and one year of updates.

FREE 2 DAY DELIVERY

Aztec C68k/Mac

Macintosh • New Release 3.4

For code quality, reliability, and solid professional features, Aztec C for the Macintosh is unbeatable. This new release includes features and functions not found in any other Macintosh C development system.

Aztec C68k/Mac-p Professional . . .$199
• MPW source level compatibility • TMON, MACSBUG, and MACNOSY support • powerful symbolic debugger • optimized C • 68000/680x0 assembler • 68881, IEEE, and SANE support • overlay linker • UNIX and Macintosh libraries • mouse editor • examples.

Aztec C68k/Mac-d Developer $299
The best of Manx, Macintosh, and UNIX. System includes: all of Aztec C68k-p • ProFiler • the UNIX utilities make, diff, grep • vi editor.

Aztec C68k/Mac-c Commercial $499
Aztec C68k/Am-d plus source for the libraries and one year of updates.

Aztec C65

New ProDOS Release

Aztec C65 is the only commercial quality C compiler for the Apple II. Aztec C65 includes C compiler, 6502/65C02 assembler, linker, library utility, UNIX libraries, special purpose libraries, shell development environment, and more. An impressive system.

Aztec C65-c Commercial $299
• runs under ProDOS • code for ProDOS or DOS 3.3

Aztec C65-d Developer. $199
• runs under DOS 3.3 • code for DOS 3.3

Aztec ROM Systems

6502/65C02 • 8080/Z80 • 8086/80x86 • 680x0

An IBM or Macintosh is not only a less expensive way to develop ROM code, it's better. Targets include the 6502/65C02, 8080/Z80, 8086/80x86, and 680x0.

Aztec C has an excellent reputation for producing compact high performance code. Our systems for under $1,000 outperform systems priced at over $10,000.

Initial Host Plus Target $750
Additional Targets $500
ROM Support Package $500

Vax, Sun, PDP-11 ROM HOSTS

Call for information on Vax, PDP-11, Sun and other host environments.

C' Prime

PC/MS-DOS • Macintosh
Apple II • TRS-80 • CP/M

These C development systems are unbeatable for the price. They are earlier versions of Aztec C that originally sold for as much as $500. Each system includes C compiler, assembler, linker, librarian, UNIX routines, and more. Special discounts are available for use as course material.

C' Prime $75

Aztec Cross Development Systems

Most Aztec C systems are available as cross development systems. Hosts include: PC/MS-DOS, Macintosh, CP/M, Vax, PDP-11, Sun, and others. Call for information and pricing.

How To Become An Aztec C User

To become a user call 800-221-0440. From NJ or international locations call 201-542-2121. Telex: 4995812 or FAX: 201-542-8386. C.O.D., VISA, MasterCard, American Express, wire (domestic and international), and terms are available. One and two day delivery available for all domestic and most international destinations.

Aztec C is available directly from Manx and from technically oriented computer and software stores. Aztec Systems bought directly from Manx have a 30 day satisfaction guarantee.

Most systems are upgradable by paying the difference in price plus $10. Site licenses, OEM, educational, and multiple copy discounts are available.

MANX

To order or for more information call today.

1-800-221-0440

In NJ or international call (201) 542-2121 • TELEX: 4995812

Circle 160 on Reader Service Card

■ Manx Software Systems
1 Industrial Way, Eatontown, NJ 07724

1. How many stars are in the Milky Way galaxy? (About 400 billion.)
2. How many of these stars have planets? (Around 40 billion.)
3. How many of these planets are suitable for life? (Estimating 10 planets per star: 40 billion.)
4. How many of the nice planets actually develop life? (For the sake of argument, 1 in 10: 4 billion.)
5. How many of these develop intelligent life? (Let's say one in a hundred with life evolves intelligence: 40 million.)
6. How many of these develop civilizations with technology capable of interstellar communication? (If even one civilization in 10 does this, there might be 4 million.)
7. How long do these civilizations last? Here McDonough does some fancy footwork. (The Earth is 5 billion years old, and the age of the universe is about 15 billion years. Suppose a civilization is communicative for a thousandth of the age of its home world—10 million years. That would mean that one-thousandth of the 4 million technological civilizations—some 4000 worlds—could be out there right now.) This all boils down to the Drake Equation: $(N = N* f_p n_e f_l f_i f_c f_L)$.

Level of Speculation

But how accurate is this intellectually stimulating model? Every one of McDonough's answers is qualified with "mights" or "supposes" or "estimates." Once we get past the first question, the slide into speculation becomes steep pretty fast. But at least it's a try.

Unlike Drake and the astronomers, the microbiologists argue from the little to the big. In a nutshell, their argument is that of all the millions of species that came into being on earth, only one (Homo sapiens) developed what could really be called intelligence. And of all the dozens and dozens of human cultures, only one (the rational, scientific subculture of Western man) developed a technology able to send and receive interstellar communication. Furthermore, all this took place only in the last 150 years. So, looking at the question from a totally biological point of view, the microbiologist makes a pretty good case for SETI's stand not being viable.

As a matter of fact, the biggest weakness in *The Search for Extraterrestrial Intelligence* is that McDonough devotes only one chapter to "Scientists Against SETI." Granted, this is an advocacy book written by an unabashed (but rational) enthusiast, but there are legitimate arguments against SETI (mathematician Frank Tipler's 1980 essay "Extraterrestrial Beings Do Not Exist" in particular), and they deserve more than the few pages McDonough offers up.

New Ideas

The final chapter of *The Search for Extraterrestrial Intelligence*, "The Future," is ostensibly about "what will happen if SETI is successful." Here, McDonough tosses out a lot of speculation and some tight ideas about culture shock—not from extraterrestrials but about what is happening on earth right now. For instance, due to satellite communications, people in Belize who never saw a baseball glove or bat have become Chicago Cubs fans. As McDonough says, "The citizens will never be the same; they have absorbed an alien culture." Some people bemoan the fact that primitive cultures are being contaminated by external influences, and some—mostly in the "primitive" cultures—think it's just dandy.

In the last analysis, the real value of this book is not that aliens may or may not be out there listening and broadcasting, but rather that such thinking and speculation generates new ideas. The door to possibility should never be latched. ■

Jack Kirwan (Department of Economics, University of Arizona, Tucson, AZ 85721) is assistant editor of The Energy Journal.

Casio challenges you to find more power. At any price.

The amazing Casio FX-4000P programmable scientific calculator. In power, it's comparable to the most highly touted calculators on the market today.

It offers you 160 total functions, including 83 scientific functions, such as hexadecimal/decimal/binary/octal conversions, standard deviation and regression analysis.

Making it easier to deal with long computations, its 12 character alpha-numeric display scrolls to 79 characters and its instant formula replay feature lets you review, edit and replay your formula at the touch of a button. It even has an answer key that stores your last computed value.

CASIO	FX-4000P
Functions	160
Display	12 Scrolls to 79
Memory	550 Step
Formula Replay	up to 79 chr.
Computer Math	Hex-Bin-Octal
Regression Analysis	2 Variable

And to make things still easier, the FX-4000P has a "perfect entry" system, which allows you to enter and display a formula exactly as written.

Plus, it has a non-volatile 550 step program memory with 10 program divisions. This allows 10 different programs to be stored at once.

And it includes up to 94 data memories, which are invaluable for statistical analysis.

Finding all this power at your fingertips is remarkable enough, let alone at half the price of some competitors. If you can put your finger on a scientific calculator that gives you more power at any price, by all means buy it.

CASIO®
Where miracles never cease

Casio, Inc. Consumer Products Division: 15 Gardner Road, Fairfield, NJ 07006 New Jersey (201) 882-1493, Los Angeles (213) 803-3411

The most powerful

Automation:
- Phonebooks store over 20 settings for each of 108 entries.
- Autopilots for each phone number can replay your logon sequence every time you dial.
- Redials busy phone numbers.
- Freeway Advanced's full-power script facility lets you run any command sequence even when you're not there.

Control:
- Freeway controls over 30 settings; Freeway Advanced controls over 50, including flow control, delays, LF filters, fold to uppercase, null line and tab expansions, and many more.

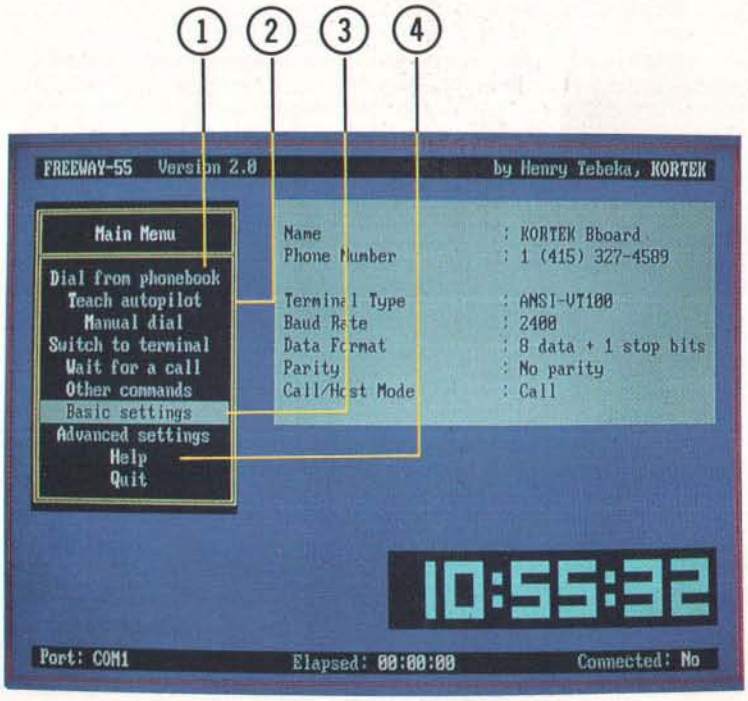
Gory Details:
- VT100, VT52, TTY, and Freeway terminal emulations. • LAPTOP TO DESKTOP LINKING CAPABILITIES.
- ASCII, Kermit, Xmodem, Ymodem, Ymodem Batch, Compuserve-B, and Freeway file transfer protocols.
- Configurable for most modems. Runs on all 100% IBM-compatible computers and the PS/2.
- Script facility includes conditional branches, subroutines, string and numeric variables, and elapsed time as a variable.
- DOS shell with access to all commands, including file and directory manipulation.
- ANSI graphics • All these features are instantly accessible through fast menus and one-key shortcuts • Cleans windows. Cooks omelettes

FREEWAY™

is the best commu

The easiest to use

Take Freeway's simple menus and clear displays. Add the arrow keys and the Escape and Enter keys. The result is powerful but straightforward communication — at your fingertips.



1 Phonebooks: Freeway lets you store the phone numbers (and other settings) for up to 100 computer systems. You just use the arrow keys to pick the number you want, hit Enter, and leave the dialing to us.

2 Autopilot: Computer communication is more than just placing a call. You have to log on to the other computer, and often type introductory commands. Freeway provides an "autopilot" to relieve you of this chore. You simply go through these preliminaries once, with the autopilot noting your every move. Then, when you next call, the autopilot will do the work for you.

3 Setting Up: Setting up Freeway is a piece of cake! The parameters you need — baud rate, parity, and even the number to call — are gathered in simple menus. To set them, you just zip through with arrows and Enter, and then save them in the Phonebook. Later, changing one or all of them is just as easy!

4 On-Line Help: Even though Freeway is very easy to use, we all need a hint now and then. Every line of every menu has on-line help at the touch of a key.

Over 30,000 satisfied users
of previous version (KX-COM)

Crosstalk® Emulation: At the touch of a function key, you can switch from the menu interface to a command line interface. Crosstalk® users will feel right at home, and everyone can use whichever interface suits them best.

Terminal Emulation and File Transfer: We haven't forgotten the basics. Freeway emulates ANSI VT-100, VT52, and TTY. It offers seven file transfer protocols, including the new ultra-fast, ultra-reliable Freeway protocol. Why a new protocol? Because it is better — it sets many parameters automatically, adapts packet sizes to line conditions, and, in short, gets files through the first time.

FREEWAY vs. other communications software packages

	Menu Driven	On-Line Help For Every Command	One-time, EASY Setup	Phonebooks/Automatic Dialing	Login Learning (Autopilot)	On-Line Page Editor	Password Protection	Script Language	Baud Rates	Crosstalk Emulation	LIST PRICE
FREEWAY	YES	YES	YES	YES	YES	YES	NO	NO	75-115.2k	NO	$ 24.95
FREEWAY Advanced	YES	YES	YES	YES	YES	YES	YES	YES	75-115.2k	YES	$ 89.95
Xtalk XVI	NO	NO	NO	NO	NO	NO	NO	YES	110-115.2k	WELL...	$195.00
Xtalk Mk.4	YES	NO	NO	YES	YES	YES	YES	YES	300-115.2k	WELL...	$245.00
Smartcom II	NO	NO	YES	LIMITED	LIMITED	NO	NO	NO	110-9600	NO	$149.00
MS Access	NO	NO	NO	LIMITED	LIMITED	YES	YES	YES	50-9600	NO	$250.00

nication software.

FREEWAY→

It seems unbelievable to get such a complete communications software package for only $24.95. But it's true! With its many powerful features, Freeway handles all your communications applications with ease. It has full terminal emulation, full file transfer capabilities, baud rates up to 115200, and many other features, and it uses all the easy Freeway interfaces with pop-up menus. Freeway is a powerful tool, and it is only **$24.95**! (non-copy protected)

$24.95 ONLY !
Introductory price

FREEWAY→ Advanced

Freeway Advanced has of course all the power and simplicity of Freeway with more features there when you need them:
- Crosstalk emulation and a powerful script language jammed with features Crosstalk® doesn't have. A BBoard script is supplied free as an application (callers can change drives, directories, and upload and download files using any protocol).
- More communication parameters; filters, flow control, delays. Passwords protect phonebooks and unattended mode. (non-copy protected)

$89.95 ONLY !
Introductory price

System Requirements: IBM PC, XT, AT, or PS/2 or 100% compatible.

Shipping In One Week!

60-Day Money-Back Guarantee

Kortek BBoard (415) 327-4589

Order now! Call toll-free 1-800/327-0310

Or, send a check or major credit card number, including $5 for postage and handling, CA residents add 7% sales tax

Crosstalk® is a registered trademark of Digital Communication Associates Inc.
Kortek Inc. has no affiliation with and no relationship with Digital Communication Associates Inc.

Dealer Inquiries Welcome.

KORTEK INC.
505 Hamilton Avenue
Palo Alto, California 94301
✆ (415) 327-4555

KORTEK

Circle 146 on Reader Service Card

Artag, Lincoln Graphics & JDLH

MICROPROCESSOR MASTERY!

The Development System that Supports 150 Different Microprocessors.

A complete solution

Here, at last, is the working environment of the future for developing error-free and efficient microprocessor code. Save time and money with UniLab II's seamlessly integrated toolset:

An 8/16-Bit Universal Emulator– With UniLab's full selection of symbolic debug commands you can quickly display and change all registers, memory, and ports, *plus* set software and hardware breakpoints.

An Advanced 48-Channel Analyzer– Most other development systems are dead in the water if there is a hardware fault, such as a simple bus short. Now, you can use the power of UniLab to home in on both software *and* hardware problems quickly.

An Input Stimulus Generator– You conveniently specify system inputs and observe the results.

A Built-In EPROM Programmer– helps finish the job!

Find Bugs Fast

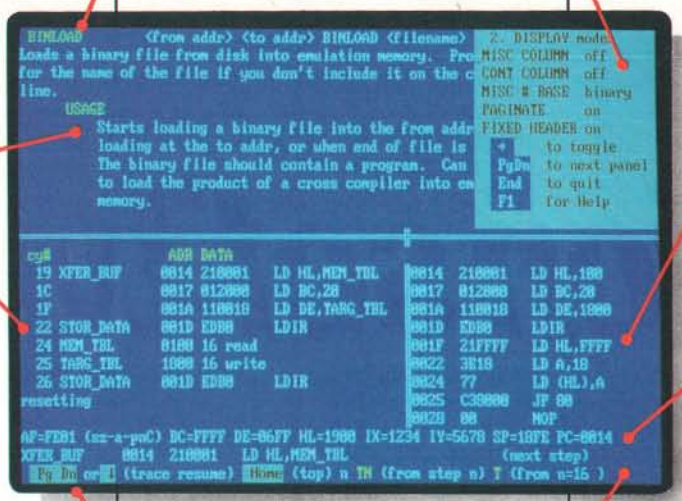
Searching for bugs by single-stepping through suspect code can take forever. Now, with UniLab, just specify the bug symptom you are looking for as a trigger spec and let UniLab catch the bug for you as your program runs in real time.

On-Line Help menus, Command Glossary, and Word List.

Pop-up Mode Selection panel called by soft key.

Windows can be used to view source files, previous traces, and more.

Symbol translation or source code line display.



Disassembly of code in memory can be compared with trace in adjacent window.

Symbolic breakpoint register display.

Screen displays scroll off into history buffer – can be viewed later.

Context sensitive prompt line.

UniLab trace filtering eliminates extraneous information and shows you only the program steps of interest.

Get Running Fast

You probably won't use your development system every day. You do need a system that's easy to learn, and easy to come back to. That's UniLab. It lets you use commands or menus – or a mixture of both. The same commands work for all MPUs. Useful help screens, an on-line manual & glossary, instant pop-up mode panels, a quick command and parameter reference, are at the ready.

Affordable, Expandable

At less than $5,000 UniLab costs less than our less-able competitors. You can add our new Program Performance Analysis option to help you optimize your software. If you don't need UniLab's power, other models are available from $2,995. Get the story on UniLab II and how it can revolutionize your software design efficiency, as it has for thousands. Universities, ask about our Education Outreach Discount Program.

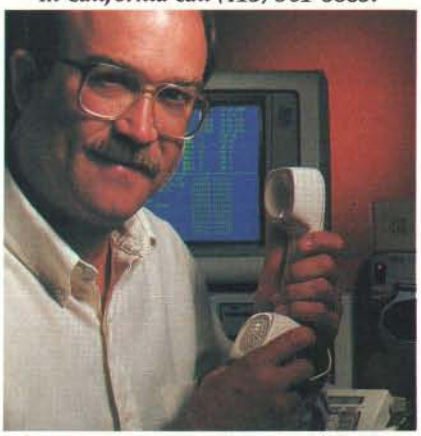
Call Toll-Free 1-800-245-8500.
In California call (415) 361-8883.

Development Dreams Come True

Use Unilab's advanced windows to set up your screen the way you want to... view multiple items of interest. Imagine being able to automatically compare a current trace with previous trace data to instantly determine differences. You can set breakpoints, single-step, then go back to the analyzer without missing a beat. If you make a change in your code, use UniLab's built-in line-by-line assembler to instantly patch the fix and test the results. Think of the time savings.

Set up for any 8– or 16–bit processor in seconds!

Thanks to our innovative emulation approach, moving between processor types requires only a new emulation module and software change. You save both money and time: Our inexpensive Personality Paks™ (only about $500) include all the items you need for fast hook-up. Orion Micro-Targets,™ functioning target circuits for popular MPUs, let you test your software before your own hardware is ready.



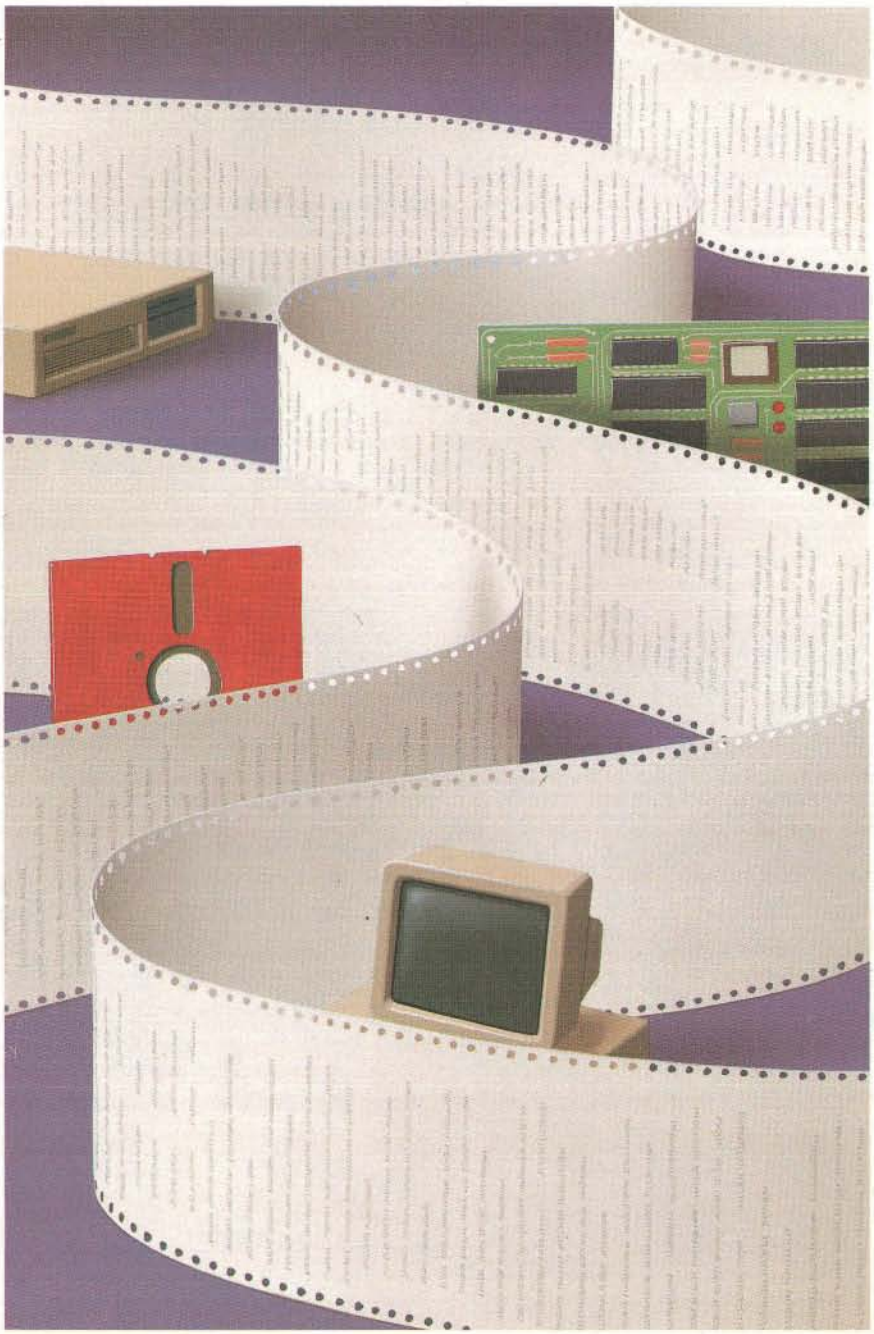
When you own or rent a UniLab II, you get access to Orion's team of Applications Engineers.

ORION INSTRUMENTS, INC.
702 Marshall St.
Redwood City, CA
94063
TELEX 530942

Circle 200 on Reader Service Card

Features

Special BIX supplement:
In "Apple II Memory Management" (found in the oct.sup conference on BIX), Howard Huang explains how to break the 64K-byte memory barrier on your Apple II programs, and presents Ultra Copy, a disk-duplicator program that employs the added RAM. For information on joining BIX, see page 267.



Rich Malloy, G. Michael Vose, and George A. Stewart

The Tandy Anniversary Product Explosion

Four new computers from the maker of the TRS-80 Model I

Ten years is a very long time in the microcomputer business. Having passed our own tenth anniversary over two years ago, we can proudly assert that this event is a notable accomplishment. Only a few microcomputer-related manufacturers have been in business that long, and fewer still have survived the myriad changes that have rocked the industry during that time. What better way to celebrate such a milestone than by introducing a complete new line of products?

Tandy did exactly that in its tenth anniversary celebration in August. The Texas-based company came out with four new computers and a laser printer. More importantly, the company says it will continue to make most of its previous products available. All told, Tandy might now be offering the most extensive line of computer products in the world (see the text box entitled "Tandy's Lineup" on the opposite page).

The four new computers are the Tandy 4000, a low-priced 80386-based computer; the Tandy 1400 LT, an IBM PC XT-compatible laptop portable; the Tandy 1000 TX, a low-priced 80286 system; and the Tandy 1000 HX, a new low-end system for home and schools. The company also introduced the LP-1000, its first laser printer.

The information for this article was gathered this past summer; we have tested early versions of each machine. If any details change by the time this article runs, we will update you as soon as possible.

Photo 1: *The Tandy 4000, an 80386-based machine.*

The Tandy 4000

Practically every company that produces MS-DOS computers seems to have come out with a computer based on Intel's 80386 microprocessor, and Tandy is no exception. The new Tandy 4000 (see photo 1) does not seem to scale any technological peaks, but, like the earlier Tandy 3000, it appears to be a good solid office workhorse. Perhaps the most significant feature of the 4000 is its price: $2599 (without a monitor or hard disk drive). This is less than many IBM PC AT-compatible systems that perform only a half to a third as fast.

It is also interesting to note that in less than a year, the price of 80386 systems has dropped by a third: from $6499 for the Compaq Deskpro 386 last September to the new Tandy 4000 ($4299 with monitor and 40-megabyte hard disk drive).

External

The Tandy 4000 comes in practically the same box as the older 3000. It measures 19 by 18 by 6½ inches. Unlike the 3000, however, it features a keylock on the front panel, and on the right side of the front panel there is room for three half-height disk drives instead of just two. Like the IBM PS/2 Model 80, the 4000 includes in

Rich Malloy and G. Michael Vose are BYTE senior technical editors, and George A. Stewart is a technical editor. They can be reached at One Phoenix Mill Lane, Peterborough, NH 03458.

its standard configuration a 1.44-megabyte 3½-inch floppy disk drive. Tandy happily points out that other types of disk drives—such as a 5¼-inch floppy—are available as options. The keyboard departs from the XT style used by the 3000 and looks very similar to the latest PC AT keyboard, complete with 12 function keys arranged horizontally, and LED indicators.

Internals

Like most 80386-based systems, the model 4000 uses a 16-megahertz 80386 processor. Tandy has employed an 80386 chip set from Chips and Technologies, and makes use of eight custom ASIC (application-specific integrated circuit) chips. A socket exists for an 8-MHz 80287 math coprocessor, with 10-MHz 80287 support slated for "the near future." Also slated for the future: Tandy will offer a new version of the 4000 that will support the Intel 80387 coprocessor.

As for memory, the 4000 can currently accommodate up to 4 megabytes. Half of this will reside on the motherboard, and the other half on a proprietary 32-bit-wide memory card. At some point in the future, when 1-megabit RAM chips become more available, the 4000's memory can be boosted to 16 megabytes.

The 4000's memory is stored on SIMMs (single in-line memory modules). Each SIMM holds nine 256K-bit chips for a total of 256K bytes of memory plus parity on each SIMM. The system uses fairly fast 100-nanosecond memory chips. The motherboard has eight SIMM sockets. When you buy the machine, four of these sockets are already filled, giving a base configuration of 1 megabyte of memory. To bring the memory up to 2 megabytes, you simply insert four more 256K-byte SIMMs, at a cost of $599. You can add another 2 megabytes using the memory-expansion board. When 1-megabit chips—and thus 1-megabyte SIMMs—become available, you can replace the eight SIMMs on the motherboard with eight 1-megabyte SIMMs, to get 8 megabytes on the motherboard.

Memory can then be further expanded by performing this same operation on the memory-expansion board, increasing the total system capacity to 16 megabytes.

The amount of memory present has an effect on the system's speed. The memory controller in the Tandy 4000 uses a page-interleaving scheme when two or four additional SIMMs are installed. The page-interleaved design allows overlapping of row and column address strobes. This overlap permits access to a memory location by changing only the column address strobe. This operation will be successful 50 percent of the time. The other 50 percent requires both a row and a column address strobe.

A Tandy 4000 with 2 megabytes of RAM is organized into 1024 pages, each containing 2K bytes with the same row address. The 2K-byte pages are arranged into two banks, with the odd-numbered pages in one bank and the even pages in the other. Two conditions allow zero-wait-state operation using this page-interleaved scheme: a subsequent memory access in the current 2K-byte page or a subsequent access in the other bank.

The page-interleaving memory controller results in a performance improve-

continued

Tandy's Lineup

Although Tandy is sometimes overlooked as a major computer company, the Texas-based retailer offers the widest selection of computers and accessories of any manufacturer in the U.S., and perhaps in the world. Here is a list of its current offerings, including the recently announced products:

Computer	Processor	Operating System	Price
Tandy 6000	68000	Xenix multiuser	$3499
Tandy 4000	80386	IBM AT compatible	$2599
Tandy 3000	80286	IBM AT compatible	$2199
Tandy 3000 HL	80286	IBM AT compatible	$1699
Tandy 2000	80186	MS-DOS	$1599
Tandy 1400 LT	NEC V-20	IBM XT-compatible laptop	$1599
Tandy 1000 TX	80286	IBM AT compatible	$1199
Model 4D	Z-80A	CP/M, TRSDOS	$1199
Tandy 1000 SX	8088	IBM XT compatible	$ 999
Tandy 1000 HX	8088	IBM XT compatible	$ 699
Tandy 1000 EX	8088	IBM XT compatible	$ 599
Tandy 200	80C85	Laptop	$ 799
Tandy 102	80C85	Laptop	$ 499
Color Computer 3	68B09E	OS-9	$ 219
Color Computer 2	6809E	OS-9	$ 99

Printer	Type	Main feature	Price
LP-1000	Laser	300 dpi	$2199
DMP 2200	Dot-matrix	380 cps	$1295
DMP 2110	Dot-matrix	24-wire printhead	$1295
DWP 520	Daisy-wheel	43 cps	$ 995
DMP 430	Dot-matrix	18-wire printhead	$ 699
DMP 130	Dot-matrix	100 cps	$ 699
DWP 230	Daisy-wheel	20 cps	$ 399
DMP 105	Dot-matrix	57 cps	$ 199

Tandy also offers a line of pocket computers, modems, and monitors, and even a plotter.

ment, although in our tests it was barely noticeable.

In addition to the proprietary 32-bit memory-expansion slot, the system has 6 IBM PC AT–style slots, and two PC XT slots. On the back panel of the system is a serial port and a parallel printer port.

Performance

Using our simple Multiplan recalculation test, we found that the 4000 was about 6.9 times faster than an IBM PC (1.53 seconds on the 4000, 10.5 seconds on the PC). In our other benchmark tests aimed specifically at the 80386 processor, the 4000 seemed to be just slightly slower than the Compaq Deskpro 386, the IBM PS/2 Model 80, and the PC's Limited 386. With 2941 Dhrystones per second, the difference was in the range of approximately 12 percent to 14 percent (the Compaq Deskpro 386 delivers 3748 Dhrystones per second, and the PCs Limited 386 yields 3846). The Sieve test showed the Tandy 4000 taking 6.07 seconds, the Compaq 5.99 seconds, and the PC's Limited 386 5.15 seconds.

Software

Like most other Tandy computers, the Phoenix BIOS–based Tandy 4000 comes with MS-DOS and BASIC included. The system also comes with three utilities: a caching utility (which now seems to be standard on high-performance computers), an expanded-memory manager that allows certain applications to make use of the memory above 640K, and a monitor program that Tandy says will allow you to have up to nine different sessions available at the same time. The user can easily switch from one session to another, but the sessions do not execute simultaneously.

Flaws

One thing we did not like about the 4000 was a report that it would pass the FCC Class A certification, but not the stricter Class B test. This means that the device causes too much electromagnetic radiation for use in most homes. Such radiation is common for 80386-based systems because of their high clock speeds. But, all in all, the 4000 looks like a solid office machine for a very reasonable price. If it performs as well as the 3000 has, then it is a very good buy, indeed.

The Tandy 1400 LT

Tandy practically invented the laptop computer, but until recently it has lacked an IBM PC compatible. The Tandy 1400 LT (see photo 2) fills that gap, and, though it has no revolutionary features, it does have all the required ones—at a very competitive price. The only disadvantage might be that, in view of its weight, it might have too many features.

Like the Tandy 100, the new 1400 LT is manufactured in Japan. Because it uses an 8-/16-bit processor, it should not, however, be affected by this year's tariff restrictions. Also, because Tandy deals with its manufacturers only in terms of dollars, the computer's low price—$1599—should remain constant despite fluctuations in the yen. At least one other company has had to raise the price of its portable because of this.

Appearance

Externally, the new machine looks a great deal like IBM's PC Convertible, including the rather significant front-to-back length. But while IBM placed several important features on option modules, the Tandy machine includes almost all the features of a desktop system as standard. The 1400 LT measures 14.5 by 12.4 by 3.5 inches, about the same size as the Convertible. It weighs 13½ pounds, a little heavy for laptops. The machine uses the familiar "clamshell" design, with a display that folds over the keyboard for travel. Immediately behind the keyboard are two 3½-inch 720K-byte floppy disk drives. On the right side of the machine are an on/off switch and a contrast control for the screen. The back panel contains a parallel port, both an RGB and a composite monitor connector, a 9-pin serial port, an external disk drive connector, and an external keyboard connector. Also on the back is an external bus connector and a small slot for an internal modem. Under the keyboard is a handle that slides forward for easy carrying.

Photo 2: *The Tandy 1400 LT laptop, a portable computer weighing 13½ pounds.*

Display

The 1400 LT has a fairly high-contrast, dark-blue-on-light-blue liquid-crystal display that makes use of supertwisted liquid crystals and electroluminescent backlighting. It looks very much like the Zenith Z-181 display, but it has a flatter aspect ratio. Like most computer LCD screens, the 1400 LT's screen can display 80 by 25 lines and has a graphics resolution of 640 by 200 pixels. However, unlike some other LCDs, the 1400 LT's screen can also display eight shades of gray (blue, actually). These multiple levels of shading are achieved by refreshing the pixels at varying intervals of time. As a result, pixels displaying the lightest shades, which are refreshed only a small number of times a second, appear to flicker. On the machine we saw, which was a preproduction model, this flicker was quite noticeable for one or two of the lighter shades; since the background was a light shade, the entire screen flickered. But the company says that on production machines, it should be less noticeable.

To save battery power, the backlighting can be turned off. Surprisingly, even with this feature turned off, the screen still has an impressive amount of contrast. The display can be adjusted to any angle and can even be placed down flat on its back against the machine if you want to use a CRT monitor instead. The display is also removable, although Tandy did not imply any future upgrade capability.

Keyboard

The 1400 LT has a fairly well-populated keyboard for its size. Its 76 keys include 12 function keys arranged horizontally

along the top, and an inverted-T cursor key arrangement in the bottom right. The keyboard is more like the Tandy 1000's than the IBM AT's. One possible problem is that, because of the front-to-back length of the computer, it may be uncomfortable for some people to use on their laps, as the keyboard may be uncomfortably close to the abdomen. This is a problem on many of the new so-called laptops.

The only things that seem to be missing from the insides of the 1400 LT are an 80286 processor and a complete AT-style expansion bus. Everything else is already there: an NEC V-20 (compatible with the Intel 8088) running at 7.14/4.77 MHz, 768K bytes of memory (128K of which is used as a RAM disk), two 3½-inch 720K-byte floppy disks, a socket for an 8087 math coprocessor, a CGA, and a real-time clock/calendar, which the company says is missing from most other laptops.

A nice feature of the RAM disk is that its contents remain intact even if the user performs a "soft reset" of the system. Tandy claims that the NEC V-20 is 10 percent to 15 percent faster than an equivalent 8088. We did a test using Microsoft's Multiplan to verify this. The test, a simple recalculation, ran about 62 percent faster on the 1400 LT's fast-speed mode (7.14 MHz) than on an IBM PC (4.77 MHz). We had expected only a 50 percent speedup due to the difference in clock speeds.

The 1400 LT uses a removable nickel-cadmium battery pack that is about the size and weight of eight C batteries. This battery pack powers the machine for about 4 hours, depending on disk usage. It can be recharged overnight, or with an AC adapter, while the 1400 LT is being used. A complete recharge takes 16 hours. For those situations requiring longer operation, a second battery pack ($79) can replace a worn-down unit. The AC power supply weighs about a pound.

Tandy claims that the 1400 LT is the closest you can get to an open architecture on a laptop. For those who would like to add a special device to the computer, an expansion port on the back of the machine accesses all the expansion bus lines. Though Tandy is not currently offering an expansion box for the 1400 LT, the company says it will provide documentation to anyone who wants to build such a device.

Those who want to attach an alternate graphics board will be relieved to hear that the company says the internal graphics adapter can be disabled. Besides an 8087, the only internal enhancement offered by Tandy is an internal 300-/1200-bit-per-second Hayes-compatible modem. This modem sells for the very competitive price of $200.

Interfaces

When it comes to interfacing capabilities, the new Tandy laptop appears to concede nothing to the low-end desktop machines. Of course, it has a serial and a parallel port. It also has both an RGB connector and a composite monitor connector, for those who prefer to see their work in color. There is even a keyboard connector, by which you can attach any of Tandy's full-size keyboards.

The big question for any 3½-inch-drive machine is: How do you connect a 5¼-inch drive to it? Tandy uses a straightforward approach to this by supplying an external disk drive connector on the back of the machine. The problem is that Tandy is not currently offering such a drive. Instead, the company suggests that users install 3½-inch drives on their desktop Tandy machines and do the conversion there, or use Traveling Soft-

continued

ware's LapLink to transfer files from the 5¼-inch desktop to the 3½-inch laptop.

Although the company does not offer a 5¼-inch drive, it did demonstrate how easily you could add one. Apparently, all you have to do is attach a power supply and the appropriate connector to the external 5¼-inch drive that Tandy sells for its Model 1000 EX. Tandy suggests that a third-party company might offer one. Note that if you were able to add an external drive, there is a switch to allow that drive to be the default boot-up drive.

Software

Unlike the Tandy Model 1000, the 1400 LT does not come standard with Tandy's DeskMate software package. The company said, however, that such bundling might occur in the future. Both MS-DOS and GWBASIC are included in the system's base price. The 1400 LT also has an interesting setup facility that allows you to set various parameters such as processor speed and the default video device.

Perhaps the only thing we don't like about the 1400 LT is its weight. It is about 1 to 3 pounds heavier than similar machines, such as the Zenith Z-181, the NEC MultiSpeed, and the Toshiba T1100 Plus. Tandy claims that one advantage of the size is that Tandy can easily add a hard disk without a major redesign. The company, however, again made it clear that it was not offering such an option at this time.

The Tandy 1400 LT seems to have all the essentials and appears to outclass all its competitors in terms of features. We applaud Tandy for not skimping on any of the necessities for the sake of a low price.

Tandy 1000 TX

Performance is the watchword of Tandy's new 1000 TX (see photo 3). The $1199 machine is based on an 80286 microprocessor running at 8 MHz (switchable to 4 MHz) with one wait state. A preliminary "working sample" of the computer equipped with an optional 80287 floating-point coprocessor ran BYTE's benchmarks at roughly the same speed as an IBM PC AT (see table 1).

The 1000 TX does not provide an AT bus architecture. As one Tandy engineer put it, the 1000 TX is "an 80286 in an IBM PC XT architecture." The most immediate implication is that all the expansion slots on the machine are for IBM PC XT–style expansion cards. The 1000 TX cannot accommodate cards designed specifically for the AT bus. Another more long-range implication is that the machine will not run OS/2.

The machine comes with 640K bytes of 150-ns RAM and a 3½-inch, 720K-byte floppy disk drive. Beyond that, it closely resembles the 1000 SX. It has a separate keyboard and system unit.

The system unit has space for a 5¼-inch device, which could be any of the following: a 20- or 40-megabyte 5¼-inch hard disk drive, or a 5¼-inch floppy disk drive, a second 3½-inch floppy disk drive, or a tape backup. A CGA, parallel and serial ports, two joystick adapters, three-voice sound, speaker, and headphone jack with volume control are all standard. The motherboard has a socket for an 80287 floating-point coprocessor, which Tandy sells for $399.95.

The system also includes Personal DeskMate 2 and MS-DOS 3.2 with GWBASIC. For a display, Tandy recommends its CM-11 RGB-intensity (RGBI) monitor ($399.95), bringing the system cost to about $1600.

Expansion

The TX allows for memory expansion to 768K bytes, of which 128K bytes are dedicated video RAM. With this addition, Tandy claims video operations are about 10 percent faster, and the user ends up with more usable RAM in the original 640K bytes. This option costs $49.95.

The 1000 TX has five expansion slots capable of accommodating IBM PC XT cards up to 10 inches long. It has no slots for AT-style cards. The technical reason is that the TX's I/O bus has only 8 data lines. AT-style cards use 16 separate data lines.

The TX would not make a practical host machine for OS/2 because its memory space is limited to 640K bytes of RAM. Additional RAM would have to be connected through the 8-bit data paths.

Of course, Tandy didn't design the machine for the OS/2 market; the TX is supposed to be a high-performance IBM PC XT–compatible suitable for workstation use, home, office, education, and small business. (The workstation angle is based on the unit's low cost and the idea that workstations rely on file servers for storage rather than on local devices.)

Photo 3: *The Tandy 1000 TX, an 80286-based version of the company's top seller.*

Performance

We ran four computational benchmarks on a TX equipped with an 80287 floating-point coprocessor, and the results show that the machine is indeed a class above the PC and XT computers. We weren't able to test disk access, but a Tandy spokesperson said I/O times were likely to be in line with XT performance, despite the presence of the 80286.

Tandy 1000 HX

It takes more than a low price to make a home computer, and Tandy has recognized this in its new 1000 HX machine (see photo 4). The $699 machine comes with a number of significant user-friendly features: MS-DOS 2.11 in ROM; a menu alternative to the A> prompt, also in ROM; a nonvolatile storage device for storing the user's system configuration; and an enhanced, ROM-based version of the company's integrated software system, Personal DeskMate 2.

Having MS-DOS in ROM means that it takes less than 3 seconds to power up. The arrangement also makes a one-disk

system more convenient to use: Upon ending a disk-based application, it isn't necessary to remove the application disk and insert a disk containing COMMAND.COM, as happens when some applications are used in a one-drive system without MS-DOS in ROM. A one-drive HX system is also practical in terms of storage capacity, since the built-in drive is a 3½-inch 720K-byte device. The unit has space available for installation of another 3½-inch drive ($169.95).

Beyond these changes, the HX closely resembles the 1000 EX that Tandy introduced in August 1986: an integrated keyboard and system unit with an 8088-2 microprocessor running at 7.16 MHz or 4.77 MHz, 256K bytes of 150-ns RAM expandable to 640K bytes, an on-board CGA, a parallel printer interface, a connector for an external 5¼-inch disk drive, and an expansion slot for one of Tandy's "Plus" circuit boards. There is no socket for an 8087 floating-point coprocessor. The rear-panel disk and printer ports are printed-circuit card edges rather than the DB plugs found on most personal computers.

The MS-DOS utilities, Personal DeskMate 2 modules, and GWBASIC are included on a 3½-inch floppy disk. A monitor is not included; Tandy recommends its CM-5 RGBI monitor, which sells for $299.95 and makes a total system price of just under $1000.

MS-DOS in ROM

According to John Patterson, senior vice president of Tandy Computers, the choice of which MS-DOS version to put in ROM was obvious. Software reliability is the primary concern, and version 2.11 has been in use for several years without having any major problems discovered.

Size is another consideration; MS-DOS versions 3.0 and higher require about 18K bytes more RAM than 2.11 requires. (MS-DOS loads and executes in RAM, regardless of whether it is stored on disk or in ROM.)

The HX actually carries 128K bytes of ROM; half of that is devoted to the Phoenix IBM compatibility BIOS version 2.51 and MS-DOS 2.11 invisible files MSDOS.SYS, IO.SYS, and COMMAND.COM. The other 64K bytes of ROM contain the HX menu program and the core routines for Personal DeskMate 2. Patterson said Tandy was considering offering some support to software developers who want to use the PDM2 ROM routines to speed and simplify the development of applications for the HX.

Nonvolatile Memory

Even though the HX comes with MS-DOS 2.11, you can use other versions by booting the computer from the 3½-inch drive or even from an optional external drive. A 16- by 16-bit EEPROM device stores the primary boot device and other information commonly specified in the CONFIG.SYS and AUTOEXEC.BAT files, including the microprocessor clock speed selection, the graphics mode, and whether to run the menu program automatically or go to the command level on boot-up.

To change the EEPROM settings, you run a setup program included on the MS-DOS utility disk.

The Menu Program

The ROM-based menu program provides a way of executing application programs without having to type `DIR` to see the directory and then type the name of the program file you want. Instead, a window shows all the `.EXE` and `.COM` files in drive A: (the internal drive). You select a program by moving the cursor to it and pressing Enter.

Function keys in the menu program allow you to activate Personal DeskMate 2, change the date and time, see the current directory in drive A:, and reboot the system from drive A:. Pressing Escape returns you to the MS-DOS `A>` prompt.

In short, the menu program provides you with quick access to the most commonly used operations without requiring you to type in any commands.

One minor deficiency of the menu program is that it does not support subdirectories; the directory window shows only those program files in the currently selected subdirectory or the root directory. To change directories, you must revert to the standard MS-DOS command level.

Personal DeskMate 2

Personal DeskMate is a graphics-oriented environment for running productivity and other software, including a calculator, notepad, calendar, phone directory, text, worksheet, and telecomm. Music is a new addition that lets you compose three-voice music in standard musical notation. Paint now offers 16 colors at once with 320- by 200-pixel resolution.

Personal DeskMate 2 includes support for an optional joystick or mouse. The HX has two joystick ports built in, and Tandy sells a $29.95 joystick that performs the pointing function reasonably well when it is set to the "free-floating" mode.

Expansion

The HX has only one expansion slot. To add more than one card, you must plug the optional memory-expansion card ($129.95) into the on-board slot. The expansion card brings the total system memory up to 512K bytes and gives two additional slots for other Plus cards. The expansion card also includes a DMA (direct memory access) chip for faster block transfers between memory and external devices.

A serial interface and a clock/calendar circuit are omitted from the basic machine. Tandy has a neat solution to the latter: an IC-size assembly that plugs into

continued

Photo 4: *The Tandy 1000 HX, an 8088-based machine with MS-DOS in ROM.*

an IC socket on the motherboard. The $39.95 option, called a Smart Watch, provides a clock and calendar function with a 10-year lithium battery.

For the serial port, Tandy offers a serial Plus card. The company is also working on obtaining a hard-disk controller Plus card through a third-party vendor (estimated price: $250), which would enable users to connect Tandy's 20-megabyte hard disk ($699).

Table 1: *Here are the results of our benchmark tests, with IBM PC AT results shown for comparison.*

	1000 TX	PC AT
Dhrystone	1456	1590
Savage	38.3	37.3
Sieve	26.8	24.6
Fibonacci	131.0	126.2

Magic Ingredient

If convenience is the magic ingredient that makes a home computer worthy of the name, Tandy may have a winner in the 1000 HX. On the other hand, some important features have been left out of this package—640K bytes of RAM as a standard complement, more expansion slots, a built-in modem, and the capacity to use the 8087 floating-point coprocessor.

Tandy's marketing people have judged these features to be nonessential to the HX's target market: home users, first-time personal computer users, and elementary, high-school, and collegiate classroom users.

The LP-1000 Laser Printer

Although Tandy has manufactured a large number of printers in the past, the Tandy LP-1000 (see photo 5) is the company's first laser printer. The printer does not break any new ground in terms of technology, but, at $2199 it does have a competitive price, especially considering how much memory is included with the printer.

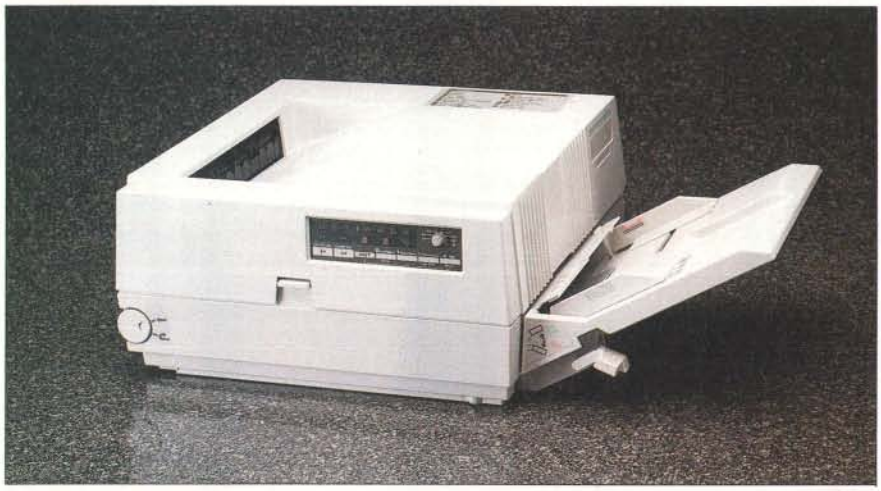


Photo 5: *The LP-1000 laser printer, a 6-page-per-minute, 300-dot-per-inch Ricoh engine printer.*

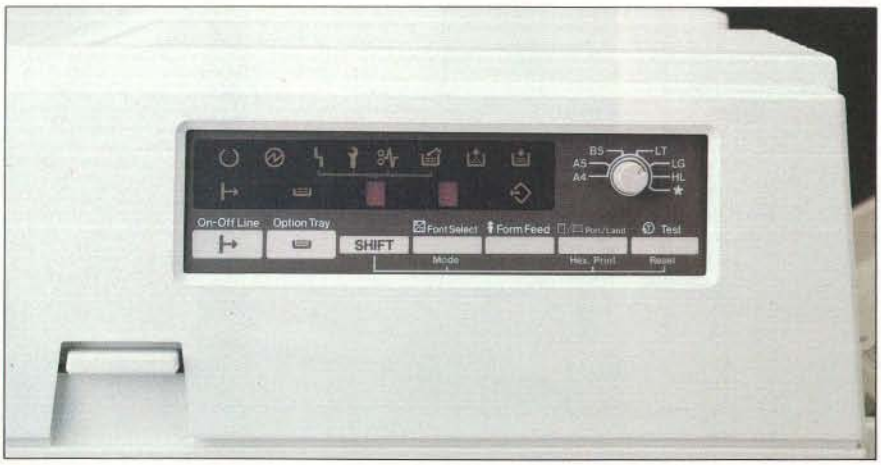


Photo 6: *The front panel of the LP-1000 laser printer.*

Like several other lasers that have come on the market this year, the Tandy printer is based on a Ricoh engine. It prints at a maximum rate of 6 pages per minute with a horizontal and vertical resolution of 300 dots per inch. Unlike many other printers, however, the LP-1000 comes standard with 1.5 megabytes of memory, enough to do full-page 300- by 300-dpi graphics.

The LP-1000 can accept letter-size or legal-size paper and has an input tray that can hold 150 sheets. The printer cannot accept envelopes, but can print on full-page label sheets. The printer stacks the printed sheets face-down in the correct order in a bin on the top of the printer. The suggested duty cycle is 3000 sheets per month.

The printer can emulate the HP LaserJet Plus, the IBM Proprinter, and the Tandy 2100 dot-matrix graphics printer. Like most laser printers, the LP-1000 has both a Centronics-style parallel interface and a video interface.

The printer can support only four fonts at any one time. Two of these are standard resident fonts, and you can download the other two. The printer does not have a socket for additional fonts. Tandy also offers a font-editing software package, which also works with its DMP 2110 dot-matrix printer, for $29.95.

The printer has no DIP switches. You can see status information and enter all changes to the printer via an LED touch panel (see photo 6) on the front of the printer. You can print out the current status of the printer at any time.

The LP-1000 is not compatible with PostScript or DDL or with any of the current controller boards that feed information through a laser printer's video interface. The company says, however, that there may be such a board available in the future, either from Tandy or a third-party manufacturer.

Not Much Missing

Tandy's current lineup of microcomputers probably represents the widest range of computers of any manufacturer in the world. These computers range from a $99 home computer to a $3499 multiuser Unix system. The company also has a sizable offering of printers, modems, and a smorgasbord of other accessories.

Only two products seem to be missing from the current collection: a write-once optical disk drive, and a CD-ROM drive. But we would not be surprised if the company were testing these devices even as these words are printed. ■

This $1595 frame grabber price won't surprise you, once you know our history.

1626: Chief Fred
Sold Manhattan for $24 worth of beads.

1803: Fred "Napoleon" Bonaparte
Sold the Louisiana territory for less than 3 cents an acre.

1987: Fred Molinari, President
Sells the DT2853 frame grabber for $1595.

Nobody gets something for nothing. But throughout history, anyone dealing with our family has come awfully close.

Take, for instance, our new DT2853 512x512x8-bit frame grabber that performs real-time image processing on the IBM PC AT. It has advanced features like built-in real-time math and logic operations; square pixel display (for perfect display without geometric distortions); and external trigger inputs (for machine vision inspection applications). And it's supported by a wealth of software.

You get all that, and it's sold for the next-to-nothing price of $1595—well below the nearest competing board!

Give us a call today. We don't offer prices like this very often, but when we do, they make history.

Call (617) 481-3700

To learn more, see us in Gold Book 1987, or call to receive our first-ever 1987 3-Book Set, including 1987 Catalog, Product Summary Price List, and Applications Handbook.

Image Processing Board	Computer	Resolution	Gray Levels	RS-170, NTSC, RS-330, CCIR, PAL Compatible	VCR Compatible	External Trig. Inputs	Square Pixels	Number of Video Inputs	Real-Time Frame Grab	Input and Output LUT's	Memory-Mapped Frame-Store Memory	Real-Time Processing	Software Support	Price
DT2853 Frame Grabber	IBM PC AT	512x512	256	Yes	Yes	Yes	Yes	8*	Yes	Yes	2 buffers 512x512x8 each (512 Kbytes)	Yes	DT-IRIS DT/Image-Pro PC SEMPER	$1,595

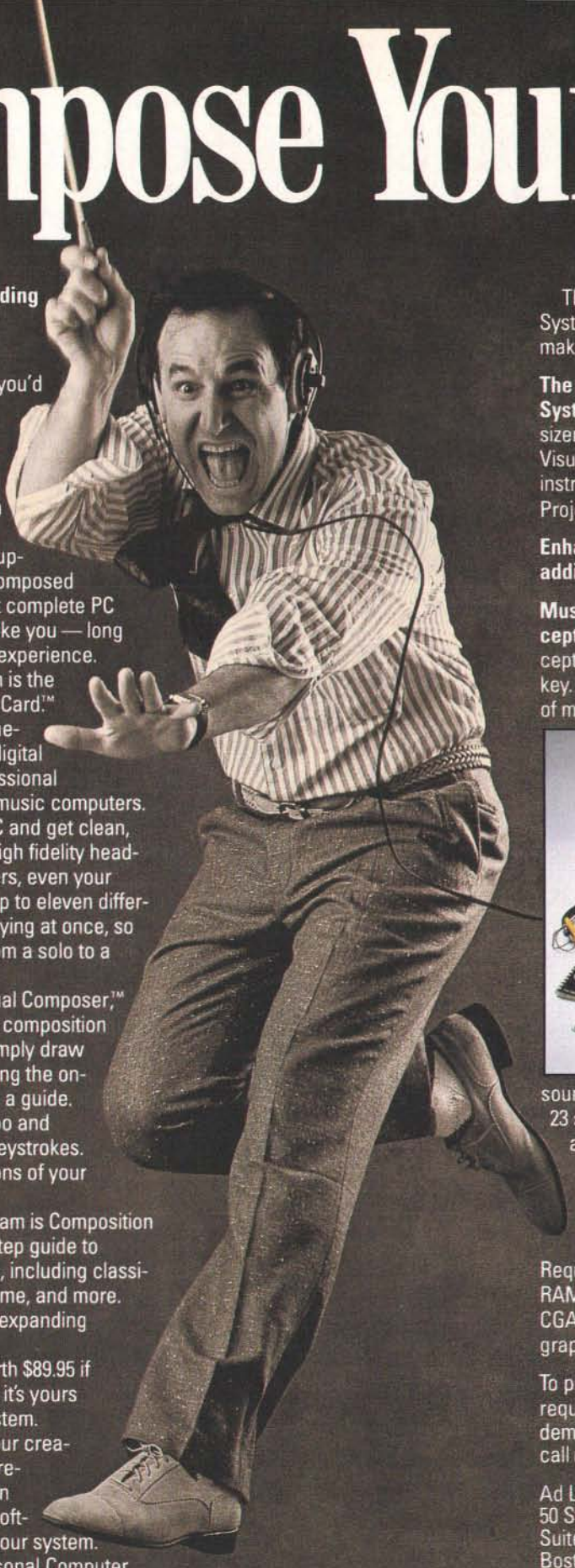
*With DT2859 ½ size multiplexer board ($395).

DATA TRANSLATION®

World Headquarters: Data Translation, Inc., 100 Locke Drive, Marlboro, MA 01752-1192, (617) 481-3700 Tlx 951646
European Headquarters: Data Translation, Ltd., The Mulberry Business Park, Wokingham, Berkshire, RG11 2QJ, U.K. (0734) 793838, Tlx 851849862
International Sales Offices: Australia (2) 662-4255; Belgium (2) 735-2135; Canada (416) 625-1907; Chile (2) 25-3689; China (408) 727-8222, (8) 721-4017; Denmark (2) 274511; Finland (90) 372-144; France (1) 69280173, (1) 69077802; Greece 951-4944, (03) 152-7039, (1) 361-4300; Hong Kong (3) 7718585; India (22) 23-1040; Israel (3) 32-4298; Italy (2) 81-821; Japan (3) 502-5550, (3) 375-1551, (3) 355-1111; Korea 778-0721/5; Morocco (9) 30-4181; Netherlands (70) 99-6360; New Zealand (9) 504-759; Norway (02) 55 90 50; Peru (14) 31-8060; Portugal (1) 545313; Singapore 7797621; South Africa (12) 46-9221; Philippines 818-0103; Spain (1) 455-8112; Sweden (8) 761-7820; Switzerland (1) 723-1410; Taiwan (2) 709-1394; United Kingdom (0734) 793838; West Germany (89) 80-9020.

Circle 80 on Reader Service Card

Compose Yourself!



Now create superb sounding music on your IBM® PC. Ad Lib™ makes it easy.

Just when you thought you'd heard it all, along comes Ad Lib.

And with it comes rich, room-filling music like you've never heard from a PC before. With rumbling bass, crystal clear highs, up-front mid-range. All of it composed and performed on the first complete PC music system for people like you — long on desire, a little short on experience.

The heart of the system is the Ad Lib Music Synthesizer Card.™ An electronic sound synthesizer based on the same digital technology found in professional keyboards and the finest music computers.

Just plug it into your PC and get clean, powerful music through high fidelity headphones, bookshelf speakers, even your home stereo. It'll handle up to eleven different instrument sounds playing at once, so it's perfect for anything from a solo to a symphony.

There's also Ad Lib Visual Composer,™ about the most instinctive composition software ever devised. Simply draw lines to indicate notes, using the on-screen piano keyboard as a guide. Change instruments, tempo and volume with a couple of keystrokes. Cut, copy and paste portions of your music in a snap.

Included with the program is Composition Projects™ #1, a step-by-step guide to creating all kinds of music, including classical, jazz, bossa nova, ragtime, and more. Just the thing for an ever-expanding repertoire.

Visual Composer is worth $89.95 if purchased separately, but it's yours free when you buy the system.

Then play back all of your creations, as well as several pre-programmed selections, on the Juke Box™ playback software, also included with your system.

Look for the Ad Lib Personal Computer Music System™ at selected computer and music stores, or order direct from Ad Lib with your check, Visa or MasterCard.

The Ad Lib Personal Computer Music System. At last, you have what it takes to make great-sounding music.

The Ad Lib Personal Computer Music System. Includes the Ad Lib Music Synthesizer Card, Juke Box playback software, free Visual Composer software with 50 pre-set instrument sounds and Composition Projects #1 . . . . . $245.00

Enhance your system further with this additional Ad Lib software:

Music Championship™ #1 — Basic Concepts. Learn to identify basic musical concepts, including tempo, mode, rhythm and key. Perfect for all ages. The first in a series of music training programs combining synthesized music with exciting computer game competition $39.95

Instrument Maker™ software. Lets you create and save new instrument sounds for use with Visual Composer. Alter 23 sound characteristics like attack, sustain and decay. Modeled after professional music synthesizer software $49.95

Look for more Ad Lib music software titles coming soon.

Requires IBM PC, XT, AT or compatible, 256K RAM, DOS 2.0 or higher, CGA, EGA or monochrome graphics adaptor.

To place your order, or to request your free demonstration recording, call us toll-free today.

Ad Lib Inc.
50 Staniford Street
Suite 800
Boston, MA 02114

Ad Lib
Personal Computer Music System

1-800-463-2686

299

Circle 334 on Reader Service Card

Ray Duncan

The OS/2 Applications Family

A look at the variety of application types that OS/2 supports

[Editor's note: *This article was adapted from* Advanced OS/2 *by Ray Duncan, to be published in January 1988 by Microsoft Press.*]

OS/2, Microsoft's long-awaited multitasking operating system for the 80286, is designed to serve as a platform for an entirely new generation of fast, highly interactive applications with a uniform graphic user interface. It is also engineered as a crucial bridge from the 1-megabyte real-mode environment to the 1-gigabyte virtual-memory protected-mode environment.

To serve as this bridge, OS/2 can run programs with a wide spectrum of characteristics and capabilities: "old" MS-DOS applications; character-oriented, dual-mode Family Apps; character-oriented, protected-mode Kernel Apps; and Windows/Presentation Manager Apps.

This broad support has led, in turn, to much unnecessary confusion among software publishers who are trying to design and position their next wave of products and among users who are trying to reconcile their upcoming equipment purchases with their long-term software needs.

In this article, I will compare the types of programs that OS/2 can run (see figure 1), briefly touch upon the development tools that are available during the interim period until the official retail release of the operating system, and then look at a sample OS/2 program. [Editor's note: *See "A Programmer's Introduction to OS/2" by Ray Duncan in the September BYTE for an overview of OS/2 features and application program structure.*]

"Old" MS-DOS Applications

OS/2 has a special module, the DOS 3.X Compatibility Box, that allows the user to run one old MS-DOS application at a time in real mode alongside one *or more* new, protected-mode applications. The Compatibility Box is not a physical box at all; it is simply a special screen group that you can enable or disable with a directive in the system's CONFIG.SYS file. Programs loaded into the Compatibility Box run on top of an MS-DOS emulator that traps MS-DOS and ROM BIOS function calls and converts them into calls to the appropriate OS/2 services and device drivers. It also provides a realistic-looking milieu for more hardware-dependent MS-DOS programs by supporting certain undocumented MS-DOS services and internal flags, supplying a "clock tick" interrupt at the appropriate frequency, maintaining a ROM BIOS data area at segment 40 hexadecimal, and so forth.

There are, of course, a few exceptionally ill-behaved MS-DOS programs that the Compatibility Box cannot handle. These include terminate-and-stay-resident utilities, which steal hardware interrupt vectors already belonging to a protected-mode device driver, reprogram the system's 8259 programmable interrupt controller, and perform other similarly nefarious deeds.

In any event, it is important to realize that MS-DOS applications gain nothing by being run under OS/2—in fact, they run slightly slower.

The Compatibility Box is only present as a temporizing measure, to protect users' software and hardware investments until a healthy variety of protected-mode software becomes available. It is ironic that, although the 3.X box is one of the crowning technical achievements of OS/2—and one of the major factors in the delay in OS/2's release—it is destined to fade away altogether (at least from users' consciousness, though it might still be present as a historical curiosity, just as the CP/M emulator cards and programs for the IBM PC had a brief heyday after the introduction of MS-DOS and then vanished forever).

Family Apps

A Family App program is written to conform to the new OS/2 Application Program Interface (API). However, it restricts itself to those OS/2 functions that have direct counterparts in MS-DOS and that do not utilize the machine instructions unique to the 80286 or 80386. After a Family App is compiled or assembled and linked into a protected-mode executable (.EXE) file in the usual manner, it goes through an additional linkage step using the utility BIND.EXE and the library file API.LIB. The result is an .EXE file that can run in protected mode under OS/2, in real mode under OS/2 in the DOS 3.X Compatibility Box, or under MS-DOS 2.x/3.x on any 8086/88, 80286, or 80386-based machine. Such programs are sometimes called *bound* or *dual-mode* applications, and nearly all the programming tools supplied in the OS/2 software development kit fall into this category.

The executable file for a Family App actually contains both an old .EXE file header and an MS-DOS–compatible program called the stub loader, and a new .EXE file header (containing segmentation and dynamic-link information) and a protected-mode program image. If you invoke such a program under OS/2 in a protected-mode screen group, the OS/2 loader inspects the new .EXE file head-

continued

Ray Duncan is president of Laboratory Microsystems Inc., and the moderator of the OS/2 conference on BIX. He can be reached at P.O. Box 10430, Marina del Rey, CA, 90295, or on BIX as rduncan.

er, brings the code and data segments that are marked "preload" into memory, resolves the dynamic links to system services, and starts up the new process in the normal fashion.

If a Family App is activated in a real-mode environment, the entire file goes into memory, and the stub loader initially receives control. The stub loader patches up each OS/2 API call within the main program to point to a routine, appended to the file by BIND.EXE, that can pop the parameters off the stack into the appropriate registers and substitute an Int 21h function call to MS-DOS. It then sets up the machine registers in accordance with OS/2's conventions and jumps to the normal entry point of the application.

A Family App is the natural first target of an experienced programmer who wants to port existing MS-DOS programs to OS/2. If said programs are already segmented according to normal .EXE file conventions, are well-behaved in their use of system memory, perform all file and record I/O using Handle function calls, and do not manipulate the keyboard or video controllers directly, then conversion is a straightforward job. The MS-DOS Int 21h calls are simply rewritten as the corresponding OS/2 API calls, and any necessary variables or structures required by the OS/2 calls are added to the program's data segment. The procedures that access command-line parameters or the environment block are adjusted appropriately, and a simple module definition (.DEF) file, describing the program's segment behavior, is created for the benefit of the linker.

Thus, transformation of an MS-DOS program into an OS/2 Family App program does not require any redesign of the program's structure or internal logic. It allows the software developer to maintain a single program and manual that can be shipped to all purchasers. On the other hand, a Family App gains little from the conversion except for the ability to execute in protected mode. Since the more sophisticated OS/2 services have no MS-DOS counterparts, they cannot be used in the program unless the developer is willing to sacrifice symmetry of its operation in all three environments. When the protected-mode Windows/Presentation Manager arrives, Family Apps will run in a window (allowing cut and paste of text from one to another) but will not support graphics operations.

Kernel Apps

A Kernel App runs only in a protected-mode screen group and uses the kernel KBD, VIO, and MOU subsystem services (i.e., keyboard, screen, and mouse I/O, respectively). Consequently, although such a program can run in a window under the Presentation Manager, it is ordinarily limited to character-oriented screen displays (if it has its own graphics drivers, it can't run in a window). On the other hand, a Kernel App has full access to OS/2's advanced features:

- It can create subprocesses (threads) that share the same data and files, child processes that run in protected memory spaces and have independent data and files, or whole new screen groups containing one or more processes writing to a separate virtual display.
- It can use all of OS/2's interprocess communication facilities (e.g., pipes, queues, semaphores, and signals) to communicate with other processes.
- It can elect to perform I/O or almost any other OS/2 operation in either synchronous or asynchronous (overlapped) fashion.
- It can create either periodic or one-shot timers and use them to schedule its own operations or those of other processes.
- It can allocate huge amounts of virtual memory.

In addition, when several protected-mode applications are closely related and contain many identical or nearly identical subroutines, you can transfer those procedures to private dynamic-link (dynalink) libraries. This reduces the size of each application's .EXE file, since the routines in dynalink libraries are bound to an application at its load time. It also allows more efficient use of memory, since concurrently executing client applications can share code segments from the library. The most important benefit of dynalink libraries, however, is simplification of code debugging and maintenance. You can modify, repair, or improve a routine in a dynalink library at any time without any change to the applications that use it, as long as you don't alter its calling sequence.

You should attempt to convert an existing MS-DOS or OS/2 Family App into a true Kernel App only after close study of both the program's fundamental mission and the services available from the OS/2 API. A clean division of the program's functionality between asynchronously executing processes or subprocesses (to fully exploit OS/2's multitasking capabilities) requires very careful planning. You must address new questions of subroutine reentrancy and synchronization of access to shared data. But the time you invest in the design phase will be amply repaid in the user's perception of application performance.

Windows/Presentation Manager Apps

Protected-mode Windows/Presentation Manager applications, like their predecessors under real-mode Windows, have a radically different internal structure and flow of control when compared to ordinary MS-DOS or OS/2 programs. The actual work performed by the program is segregated into several relatively autonomous routines known as window processors, each associated with a specific screen region, such as a parent window, a child window, a dialog box, and so on. The main routine of a Windows App is a relatively simple loop that reads a message off the program's input queue, optionally performs some translation on the message, and then redispatches the message to a window processor within the same application or in another. The message might consist of a key press, key release, a mouse movement, a signal from the system to repaint part of a window, or a notification that the application has been "iconized."

Conceptually, a Windows App requires a complete reversal of viewpoint on the part of the programmer. Instead of the application driving the environment, the environment drives the application. Instead of the application requesting a character from the keyboard or polling the mouse position when it is good and ready, the application is constantly being bombarded with messages from the system about events that are totally outside of

continued

Application Type	Runs under:			
	MS-DOS 2.x/3.x	OS/2 Real-Mode Box	OS/2 Protected Mode	OS/2 Windows/ Presentation Manager
MS-DOS App	Yes	Yes	No	No
Family App	Yes	Yes	Yes	Yes
Kernel App	No	No	Yes	Yes
Windows App	No	No	No	Yes

Figure 1: *A comparison of various types of applications that can run under OS/2.*

ASYSTANT+™ ... Menu Driven Engineering And Scientific Software Brings New Power To Your PC!

Data acquisition, analysis, statistics and astounding graphics in one easy to use, integrated and affordable package.

ASYSTANT+ is a software package designed exclusively for engineers and scientists who use a PC as a personal productivity tool. It offers **fully integrated** data acquisition, data analysis and astounding graphic capabilities.

This powerful software is menu driven to get you up and running immediately and provides an interactive and very clear help menu.

Here are just a few of the powerful features:

- A/D, D/A, Data Acquisition and Control
- Full integration to eliminate program shuffling
- Outstanding presentation quality graphics which easily outputs to plotters
- Built-in, ready to run functions include FFT, smoothing, curvefitting, statistics, matrix and polynomial operations... and more

ASYSTANT+ has no equal, either in power or functionality. With this software the time consuming requirements of custom programming are eliminated. With this software you no longer have to settle for "business oriented spread sheets" or multiple programs from several sources. With this software you can unlock your engineering and scientific potential while expanding your productivity.

ASYSTANT+ is what engineering and scientific software is supposed to be... productive, powerful and capable of handling your toughest assignments.

Best of all, it's easy to install, easy to use and very affordable.

Call us today for more detailed information.

1-800-348-0033

ASYST
SOFTWARE TECHNOLOGIES, INC.

100 Corporate Woods • Rochester, N.Y. 14623

ASYSTANT + Ready-to-Run Scientific Software is a trademark of Asyst Software Technologies, Inc.

its control—and it must dispose of these messages quickly (for example, most users would consider any perceptible delay between clicking on a menu bar and the appearance of the pull-down menu as intolerably poor performance).

Aside from design considerations, a move to Windows programming requires a programmer with true grit: There is no such thing as a trivial Windows program. Even the traditional "Hello, World!" program is several pages of C code, and the logic to scroll a window correctly under all possible circumstances adds a couple more pages.

For those programmers who haven't yet gotten the message about Microsoft's love affair with C, an encounter with Windows can be a real crash landing. The Windows libraries are C libraries, the manuals and example programs assume a fluent knowledge of C, and any attempt to write a Windows App in any other high-level language or even (perish the thought) in Macro Assembler are vigorously discouraged by the Microsoft support personnel.

Needless to say, those few developers who have already written real-mode Windows applications have a significant head start, but even their lot is not easy. Although protected-mode Windows/Presentation Manager has the same user interface as real-mode Windows 2.0, the system interface at the application program level is somewhat different. Developers of Windows Apps will have to maintain two sets of source code, one for protected mode and one for real mode, and just pray that the two systems don't diverge too much over the years.

What do Windows App developers get for their pains? A dramatically shortened user learning curve, access to a battery of graphic drawing and "rich text" display functions that would take years to duplicate, ready exchange of all types of data with other Windows Apps, and eternal relief from the dreary job of writing and optimizing a new device driver for every video adapter, printer, and pointing device that appears on the market. The burden of writing a general-purpose Windows driver for new hardware is shifted to the manufacturer—where it belongs.

The Tools

The Microsoft OS/2 Software Development Kit (SDK) established some historic precedents when it landed on purchasers' doorsteps with a thump on the morning of May 29. It was certainly the most formidable software package ever shipped by Microsoft, arriving in a box nearly 3 feet long and weighing roughly 30 pounds. It was the most expensive Microsoft product ever, at a cost of $3000 per copy (to be fair, this includes automatic software updates, a year's technical support, and attendance at a three-day OS/2 seminar). It was the first time in my memory that Microsoft had delivered a product two months before its announced release date.

And last, but not least, it was the first time that Microsoft had ever asked developers to *pay* to be beta testers.

The SDK's nine high-density (1.2-megabyte) disks contain a prerelease version of the OS/2 operating system and its associated utility programs, dual-mode versions of the Microsoft C Compiler, Macro Assembler, Linker, MAKE, BIND, protected-mode CodeView, source code for many example programs, and even a fully configurable visual editor. The documentation fills eight binders, totaling some 3100 pages. The first SDKs did not include the software and documentation (an additional three manuals containing another thousand pages collectively) for the Windows/Presentation Manager graphic interface that was scheduled to be delivered as part of an update by the time this article appears.

To use the OS/2 SDK, you need a PC AT or compatible with a hard disk and at least 1.5 megabytes of RAM, room on the disk for 10 megabytes or so of programs, libraries, and example source code, and a lot of patience. The OS/2 kernel alone supports over 200 functions that can be called by application programs, and the Windows/Presentation Manager layer adds some 500 more. The days when a PC programmer could get by with a $20 MS-DOS reference book, a runtime library manual for his or her favorite language, and a quick reference card to the Intel 80x86 instruction set are gone.

An Example Kernel App

As an example of an OS/2 Kernel App to accompany this article, I have written two implementations of a file-dumping utility in C and Macro Assembler. The utility accepts a filename on the command line and displays the binary contents of that file, in hexadecimal bytes and their ASCII character equivalents, on the standard output device (and may be redirected into a file or to the printer). Such a utility is indispensable when trying to decipher the format of undocumented data files, load modules, and the like. The C source code (from the file DUMP.C) is in listing 1. [Editor's note: *DUMP.C, DUMP.ASM, and DUMP.DEF, which contain the source code for these two implementations, are available on disk, in print, and on BIX; see the insert card following page 304 for details. Listings are also available from BYTEnet; see page 4 for details.*]

Although file-dumping utilities per se are common and not very interesting, these particular programs have been intentionally complicated in order to illustrate some of the powerful capabilities of OS/2. They perform overlapped I/O by creating separate threads to handle the disk reads and screen writes.

The threads use a double-buffering scheme and coordinate their access to the buffers with semaphores. Figure 2 shows a sketch of the general logic of the DUMP program.

The C example demonstrates the ease with which OS/2 services may be called

continued

Listing 1: *DUMP.C, the source code for the C version of the Kernel App example.*

```
/*
        DUMP.C          Displays the binary contents of a file in hexadecimal
                        and ASCII on the standard output device.

                        Program has been deliberately complicated to
                        demonstrate direct calls from C to operating
                        system, use of multiple threads, and
                        synchronization with semaphores.

        Usage is:       C>DUMP unit:path\filename.ext
                        [>destination]

        Compile with: C>CL /AL /Zi /Gs /F 2000 DUMP.C
*/

#include <stdio.h>
#include <malloc.h>
#include <doscalls.h>

#define REC_SIZE 16                     /* size of file records */
#define STK_SIZE 1024                   /* stack size for threads */
```

continued

TAKE THE 5-VOLUME UNIX PROGRAMMER'S MANUAL

for only $9.95 when you join The Library of Computer and Information Sciences

You simply agree to buy three more books—at handsome discounts—within the next 12 months.

THE UNIX BIBLE

System V is here. You'll want the latest edition to the most comprehensive reference to the UNIX operating system. Take the UNIX Programmer's Manual, now in an expanded five-volume set.

VOLUME 1

Commands and Utilities.

Take command of the most important applications and utilities available in the UNIX system. From the special functions of the DASI 300 and 300A terminals to user details on many UNIX implementations. Plus, you'll find information and cross references for quick how-tos and easy problem solving.

VOLUME 2

System Calls and Library Routines

Now feel completely at ease with UNIX programming features: system calls, subroutines, libraries, file formats, macro packages, character set tables, and more. A valuable technical manual for the computer professional.

VOLUME 3

System Administration Facilities

This is your guide to efficiently administrating the UNIX system. Change, debug, kill, copy or compile, execute important system maintenance commands and procedures, use application programs and special files.

VOLUME 4

Documentation Preparation

You'll find detailed examples, practical commands and memorandum macros to help you create and format documents. Includes step-by-step tutorials on nroff and troff, advanced editing commands, the stream editor (sed), preprocessors, plus tbl and eqn to prepare tables and typeset mathematics, and more.

VOLUME 5

Languages and Support Tools

An indispensable reference tool, volume 5 explains languages and software tools critical to the system user. In this expanded and enriched handbook, you'll find guides to: Fortran and C programming, make, M4 Macro Processor, awk, Link Editor, Common Object File Format, Interactive Desk Calculator, Lexical Analyzer Generator, and much more.

The Library of Computer and Information Sciences is the oldest, largest book club especially designed for computer professionals. In the incredibly fast-moving world of data processing, where up-to-the-moment knowledge is essential, we make it easy to keep totally informed on all areas of the information sciences. What's more, our selections offer you discounts of up to 30% or more off publishers' prices.

4 Good Reasons to Join

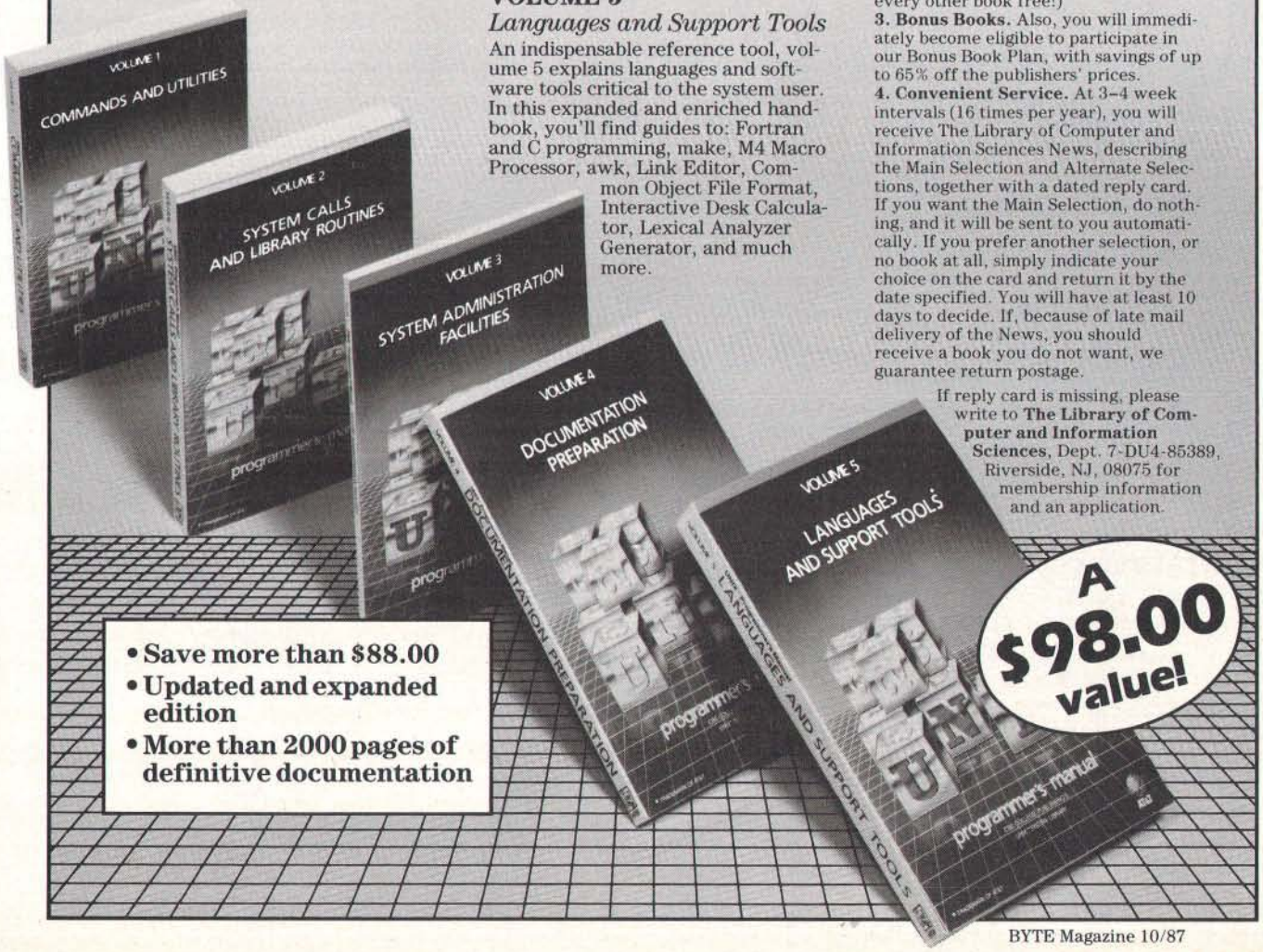
1. The Finest Books. Of the hundreds of books submitted to us each year, only the very finest are selected and offered. Moreover, our books are always of equal quality to publishers' editions, *never* economy editions.

2. Big Savings. In addition to getting the 5-vol. UNIX Programming Library for only $9.95 when you join, you keep saving substantially, up to 30% and occasionally even more. (For example, your total savings as a trial member—including this introductory offer—can easily be over 50%. That's like getting every other book free!)

3. Bonus Books. Also, you will immediately become eligible to participate in our Bonus Book Plan, with savings of up to 65% off the publishers' prices.

4. Convenient Service. At 3–4 week intervals (16 times per year), you will receive The Library of Computer and Information Sciences News, describing the Main Selection and Alternate Selections, together with a dated reply card. If you want the Main Selection, do nothing, and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.

If reply card is missing, please write to **The Library of Computer and Information Sciences**, Dept. 7-DU4-85389, Riverside, NJ, 08075 for membership information and an application.



- **Save more than $88.00**
- **Updated and expanded edition**
- **More than 2000 pages of definitive documentation**

A $98.00 value!

```
char Buf1[REC_SIZE];                    /* first disk buffer */
unsigned Buf1Len;                       /* amount of data in buffer */

char Buf2[REC_SIZE];                    /* second disk buffer */
unsigned Buf2Len;                       /* amount of data in buffer */

unsigned Handle;                        /* file Handle from DOSOPEN */
long filptr;                            /* file offset in bytes */

unsigned long ExitSem;                  /* semaphore for process exit */
unsigned long Buf1FullSem;              /* semaphores for disk buffer 1 */
unsigned long Buf1EmptySem;
unsigned long Buf2FullSem;              /* semaphores for disk buffer 2 */
unsigned long Buf2EmptySem;

main(int argc, char *argv[])
{
  void far DisplayThr();                /* entry point for Display Thread */
  void far DiskThr();                   /* entry point for Disk Thread */

  unsigned DisplayThrID;                /* receives Thread ID */
  unsigned DiskThrID;                   /* receives Thread ID */

  char DisplayThrStk[STK_SIZE];         /* allocate stacks for threads */
  char DiskThrStk[STK_SIZE];
  int action;                           /* receives DOSOPEN result */
  int openflag=0x01;                    /* fail open if file not found */
  int openmode=0x40;                    /* read only, deny none */

  filptr=0L;                            /* initialize file pointer */

  ExitSem=0L;                           /* initialize semaphores */

  Buf1EmptySem=Buf1FullSem=0L;
  Buf2EmptySem=Buf2FullSem=0L;
  DOSSEMSET((long) &ExitSem);
  DOSSEMSET((long) &Buf1FullSem);
  DOSSEMSET((long) &Buf2FullSem);

  if (argc < 2)                                 /* check command tail */
  {   fprintf(stderr,"\ndump: missing file name\n");
      exit(1);
  }
                                        /* open file or exit */
  if (DOSOPEN(argv[1],&Handle,&action,0L,0,openflag,openmode,0L))
  {   fprintf(stderr,"\ndump: can't find file %s\n",argv[1]);
      exit(1);
  }
                                        /* create Disk Thread */
  if (DOSCREATETHREAD(DiskThr,&DiskThrID,DiskThrStk+STK_SIZE))
  {   fprintf(stderr,"\ndump: can't create Disk Thread");
      exit(1);
  }
                                        /* create Display Thread */
  if (DOSCREATETHREAD(DisplayThr,&DisplayThrID,DisplayThrStk+STK_SIZE))
  {   fprintf(stderr,"\ndump: can't create Display Thread");
      exit(1);
  }

  DOSSEMWAIT((long) &ExitSem,-1L);      /* wait for exit signal */

  DOSSUSPENDTHREAD(DiskThrID);          /* suspend other threads */
  DOSSUSPENDTHREAD(DisplayThrID);
  DOSCLOSE(Handle);                     /* close file */
  DOSEXIT(1,0);                         /* terminate all threads */
}

/*
      The Disk Thread reads the disk file, alternating between Buf1
      and Buf2. This thread gets terminated externally when the
```

continued

New FoxBASE+ 2.00

Blazing Speed
New Features
Easier to Use

Complete dBASE III PLUS Replacement. . . And Much More

Don't change your programs, databases, screens, or reports!

FoxBASE+ makes your dBASE applications run like lightning *without changing one line*. And you can still use the best parts of dBASE—great interactive features like EDIT and BROWSE *plus* the full power of the "dot-prompt." Use FoxBASE+ in exactly the same, familiar, user-friendly way you use dBASE.

30+ Major Enhancements

User-Defined Functions, screen save & restore, VALID clause in GET's, built-in "light-bar" menus, 10 new commands, 4 new functions, and *much* more.

Faster Than Fast

FoxBASE+ was already the fastest dBASE product in existence—but based on *independent* benchmarks,* new FoxBASE+ 2.00 averages 73% faster. That's an average 3.2 times faster than Clipper, 4.3 times faster than Quicksilver, and 5.9 times faster than dBASE III PLUS.

80386 Version Available NOW

For ultimate speed *now*, FoxBASE+/386 runs about 50% faster than standard FoxBASE+ 2.00—over 10 times faster in some operations. It takes full advantage of protected mode and the giant memory capacity of the 80386 chip *today* . . .yet runs under standard MS-DOS.

Easier To Use

Don't worry about memory configuration or size. New FoxBASE+ 2.00 *automatically* optimizes memory usage as it runs. . . requires less memory yet runs faster. And because FoxBASE+ is completely interactive, you don't have to waste hours compiling and linking your programs.

FoxBASE+ Is Economical

Best of all, single-user MS-DOS FoxBASE+ 2.00 costs just $395 and FoxBASE+/386 2.00 just $595. Multi-user versions are also available.** And with our Royalty-Free Runtime you can distribute your FoxBASE+ applications freely and never pay another dime.

FoxBASE+ runs on the new IBM Personal System/2 and 3.5″ diskettes are available at no additional cost.

So call (419) 874-0162 and ask for the details about FoxBASE+ 2.00 and our **money-back guarantee**. After all. . .

Nothing Runs Like a Fox.

FoxBASE

* Using the suite of 48 comprehensive benchmarks published in Data Based Advisor, March 1987.

** Multi-User FoxBASE+ 2.00 for MS-DOS costs $595. Multi-User XENIX version available at $795.

Fox Software
27493 Holiday Lane, Perrysburg, Ohio 43551
(419) 874-0162 Telex: 6503040827 FOX
FAX: 4198748678

```
      other threads (see end of file) have been reached.          */
void far DiskThr()
{
  while(1)
  {   DOSREAD(Handle,Buf1,REC_SIZE,&Buf1Len); /* read disk */
      SemFlip(&Buf1EmptySem,&Buf1FullSem);    /* mark buffer 1 full */
      DOSSEMWAIT((long) &Buf2EmptySem,-1L);   /* wait for buffer 2 empty */
      DOSREAD(Handle,Buf2,REC_SIZE,&Buf2Len); /* read disk */
      SemFlip(&Buf2EmptySem,&Buf2FullSem);    /* mark buffer 2 full */
      DOSSEMWAIT((long) &Buf1EmptySem,-1L);   /* wait for buffer 1 empty */
  }
}

/*
      The Display Thread formats and displays the data in the disk
      buffers, alternating between Buf1 and Buf2.          */
void far DisplayThr()
{
  while(1)
  {   DOSSEMWAIT((long) &Buf1FullSem,-1L);    /* wait for buffer 1 full */
      DumpRec(Buf1,Buf1Len);                  /* format and display it */
      SemFlip(&Buf1FullSem,&Buf1EmptySem);    /* mark buffer 1 empty */
      DOSSEMWAIT((long) &Buf2FullSem,-1L);    /* wait for buffer 2 full */
      DumpRec(Buf2,Buf2Len);                  /* format and display it */
      SemFlip(&Buf2FullSem,&Buf2EmptySem);    /* mark buffer 2 empty */
  }
}

/*
      Display record in hexadecimal and ASCII on standard output.
      Clear exit semaphore and terminate thread if record length=0. */
DumpRec(char *buffer,int length)
{
  int i;                                  /* index to current record */

  if (length==0)                          /* check if record length = 0 */
  {  DOSSEMCLEAR((long) &ExitSem);        /* yes, signal main thread */
     DOSEXIT(0,0);                        /* and terminate this thread */
  }

  if (filptr % 128 == 0)                              /* maybe print heading */
     printf("\n\n      0 1 2 3 4 5 6 7 8 9 A B C D E F");

  printf("\n%04lX ",filptr);              /* file offset */

  for (i = 0; i < length; i++)            /* print hex equiv. of each byte */
     printf( " %02X", (unsigned char) buffer[i] );

                                          /* space over if partial record */
  if (length != 16) for(i=0; i<(16-length); i++) printf("   ");

  printf("  ");

  for (i = 0; i < length; i++)            /* print ASCII equiv. of bytes */
      {  if (buffer[i] < 32 || buffer[i] > 126) putchar('.');
         else putchar(buffer[i]);
      }

  filptr += REC_SIZE;                     /* update file offset */
}

/*
      Since there is no operation to wait until a semaphore is set, we
      must maintain two semaphores to control each buffer and flip
      them atomically.                                                  */
SemFlip(long *sem1, long *sem2)
{  DOSENTERCRITSEC();                     /* block other threads */
   DOSSEMSET((long) sem1);                /* set the first semaphore */
   DOSSEMCLEAR((long) sem2);              /* clear the second semaphore */
   DOSEXITCRITSEC();                      /* unblock other threads */
}
```

NOW DINERS CLUB HOLDS THE KEY TO BONUS FREQUENT STAYER POINTS AT HILTON, INTER·CONTINENTAL, RADISSON, RAMADA AND SHERATON HOTELS.

From now on, when you use the Diners Club Card, you can earn Club Rewards℠ points good towards exciting gifts and services. Including frequent stayer credit at the participating hotel of your choice. Which can earn you a free room upgrade or even a free suite. Or, you can choose frequent flyer miles on American, Continental, Northwest, TWA or United* airlines.

So dine with the Diners Club Card. Sleep on it. Rent with it. Whatever. And watch your frequent stayer credit grow. Or use someone else's card...and miss out on a very suite deal.

Call 1-800-DINERS-1. Join the Club. The rewards are endless.

Frequent Traveler benefits available through the Club Rewards℠ program. Participating companies subject to change. Club Rewards is a service available only to Personal Cardmembers of Diners Club from Citicorp located within the 50 United States. Free enrollment required. Certain terms and conditions apply. Free suites available at selected hotels. *United participation limited to 1986/87 Club Rewards brochure.

directly from a high-level language. The assembly language version, DUMP.ASM, also contains two procedures that Macro Assembler programmers should find useful in other programs. The routines are called ARGC and ARGV, and they return the number of command-tail arguments and pointers to those arguments, similar to C's `argc` and `argv`.

Assembling and Linking DUMP.ASM

First, use the Microsoft Macro Assembler to assemble the file DUMP.ASM into the relocatable object module DUMP.OBJ with the following command line:

```
[C:\] MASM /L /Zi DUMP
```

The optional `/L` and `/Zi` switches in the `MASM` command line request the creation of a program-listing file and the inclusion of symbolic debugging information in the relocatable object file, respectively.

To link the file DUMP.OBJ, the module-definition file DUMP.DEF, and the OS/2 API dynalink reference file DOSCALLS.LIB into the executable application DUMP.EXE, enter:

```
[C:\] LINK DUMP,,,DOSCALLS,DUMP
```

You can then run the DUMP utility with a command of the form:

```
[C:\] DUMP MYFILE.DAT
```

Compiling and Linking DUMP.C

The C compiler has a control program, CL.EXE, that automatically runs the preprocessor, the various passes of the compiler, and the linker for you. To compile and link the file DUMP.C, together with the library DOSCALLS.LIB and the module-definition file DUMP.DEF, into the executable DUMP.EXE, enter the command line:

```
[C:\] CL /AL /Zi /Gs /F 2000
      DUMP.C
```

The `/AL` switch specifies a "large model" program, while the `/Zi` switch (again) specifies that the linker should include symbolic debugging information in the object module and in the final executable file. I prefer to use the large model for most of the OS/2 utility programs I write in C because the compiler then generates "long" addresses for the parameters supplied in direct calls to OS/2 services without the need for any special typecasting.

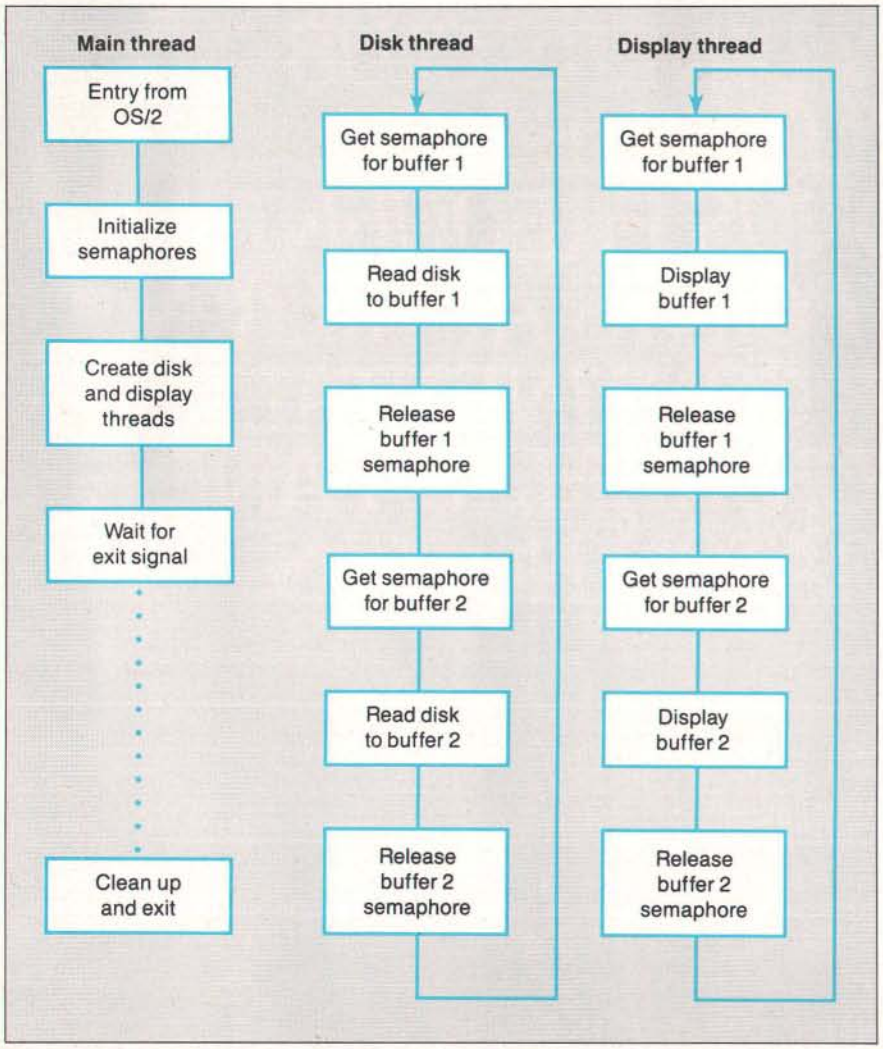


Figure 2: *A sketch of program logic for the DUMP example program. Separate subprocesses (threads) are used to perform the disk file reads, and the formatting and display. Two semaphores provide mutual exclusion on the I/O buffers. The main thread simply waits until the other two threads are done, unless a critical error or other external event activates it in the meantime.*

To Port a Program

If you want to port an existing MS-DOS application to OS/2, or develop an entirely new OS/2-based product, you must make some early implementation decisions based on the specific characteristics and needs of your application.

You can quickly port products that require a minimum of user interaction and have no need for graphics, such as compilers, linkers, and similar tools, to OS/2 as Family Apps. This gives you the added advantage of being able to ship a single disk and manual for MS-DOS 2.x/3.x, the OS/2 DOS 3.X Compatibility Box, and OS/2 protected mode.

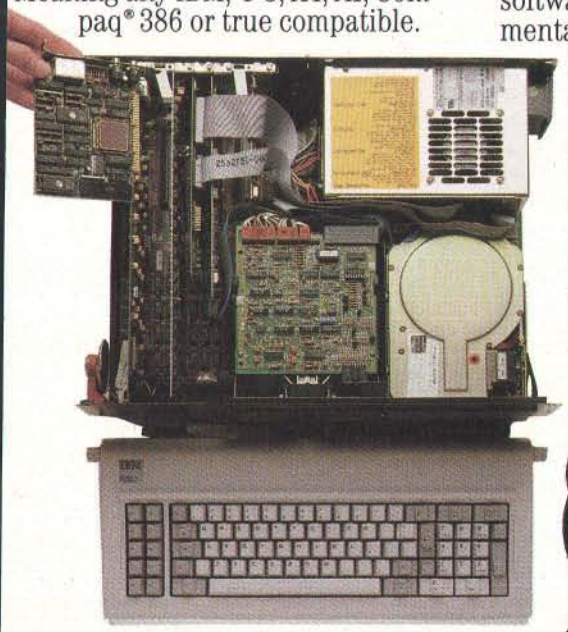
You can write highly interactive applications with no need for graphics (e.g., communications programs) as character-oriented Kernel Apps and reap the benefits of OS/2's protected-mode services. While not as straightforward as a Family App port, a Kernel App is still relatively easy to write and will run in a window under the Presentation Manager, if necessary. Most of the commercial products released for OS/2 in the next year or so will undoubtedly fall into this category.

Finally, if you need to port graphics-oriented applications to OS/2, you have a choice between revamping your program as a true Windows/Presentation Manager App, or going it alone and providing your own graphics routines. If you choose the latter course, your program might be published sooner, but it will lose the ability to run in a window alongside of (and exchange data with) other Windows/Presentation Manager Apps, and you forfeit the advantages of the common graphic user interface. You will also waste time writing hardware-dependent drivers that might be better spent on user-oriented enhancements. ■

VIDEOTRAX DATA BACK-UP. WE JUST INTRODUCED IT. AND ALREADY 40 MILLION PEOPLE OWN HALF OF IT.

Every human in the hemisphere who owns a standard VCR has half of what's needed to back up data. The rest of what you need is neatly contained on the new Videotrax® controller board by Alpha Micro.

Slip the half-size Videotrax board into the expansion slot of any PC. Meaning any IBM,® PC, XT, AT, Compaq® 386 or true compatible.



High-tech. Open your PC and slide the controller board into any expansion slot. Low-tech. Hook up VCR to computer with standard connector cables.

Connect the computer to a VCR with standard connector cables. And, as of that moment, you are under the protection of a highly sophisticated, stringently reliable, data backup system.

In fact, exhaustive testing and the long term experience of over 19,000 Alpha Micro users have proven Videotrax technology to be more reliable than any other backup option available. More dependable, even, than the hard disk you're covering for.

QUICK STUDY

Videotrax has been designed to extremely demanding standards. So that it won't put a lot of demands on you. Anyone who can run a VCR knows most of the drill. The rest is covered by our menu-driven software. By clear, concise documentation. And by a range of backup modes that keeps it simple:

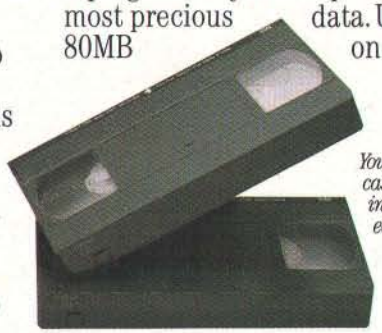
Insert a blank video cassette tape and follow the directions which appear on screen. These guide you through the painless steps for copying or restoring an entire hard disk, specific files, or only files modified since the last backup.

Meanwhile, Videotrax rigorously monitors itself for proper functioning.

WE MAKE THE VCR PART OF IT, TOO.

If you like, opt for our enhanced Videotrax VCR and experience the extra joy of its automatic, unattended backup capabilities.

It will be a most prudent investment. Because, for the price of taping Dallas you can preserve your most precious 80MB data. Up to on a single



Your basic video cassettes. Reliable, inexpensive, easy to find.

cassette, at less than a tenth of the cost of streamer tape.

And now the price is low. Just $399 for the board and $1199 for the board and enhanced VCR, suggested retail.

And of course, if you ever require service, your authorized Alpha Micro dealer and our worldwide network of factory service centers will provide all the support you need.

For the name of your nearest Videotrax dealer, call Alpha Micro at 1-800-992-9779. In California, call 1-800-821-0612.

The Videotrax System. It's a great leap forward in backing up.

VIDEOTRAX™
DATA BACKUP FROM ALPHA MICRO.

Circle 8 on Reader Service Card (Dealers: 9)

Available at Radio Shack Computer Centers®/Plus Computer Centers and other fine computer dealers worldwide.

Before you choose between the best PC terminals, read this head-on comparison.

Totally compatible with the IBM AT, right down to keyboard layout. But with a more resilient feel.	Likewise.
14", 132 column, high resolution screen gets more out of programs like Multiplan and Lotus 1-2-3.	Likewise.
Boosts productivity with easy to read character set and advanced ergonomics.	Likewise.
Manufactured, serviced and supported by the company that ships more terminals than anyone but IBM.*	Likewise.
At $599, the Wyse WY-60 delivers unrivaled value if you're looking for sharp resolution, advanced features and superior overall quality in an AT-compatible alphanumeric terminal.	At $649, the Wyse WY-99GT delivers likewise in a graphics terminal, with Hercules and IBM CGA compatibility.

So if you're looking for the best terminal to turn your AT into a multi-user system, there's really no choice like Wyse. For more information, call 1-800-GET-WYSE.

WYSE

We make it better, or we just don't make it.

Ezra Shapiro

A Spiritual Heir to the Macintosh

The Canon Cat may be Jef Raskin's long-sought "information appliance"

Editor's note: *The following is a BYTE product preview. It is* not *a review. We provide an advance look at this new product because we feel it is significant.*

The Canon Cat is being advertised as a piece of office equipment—the next step beyond the memory typewriter—but there's some real computer muscle under this feline's skin. It's Jef Raskin's first machine since he left Apple, where he headed the original Macintosh development team. And, as you might expect from this pedigree, the Cat takes an innovative approach to computing in the business environment.

Like the Macintosh, the Cat is a one-piece unit with a 9-inch black-and-white bit-mapped monitor, a single 3½-inch floppy disk drive, a small footprint, a Motorola 68000 CPU, and a user interface built into ROM. However, that's where the similarity ends; the Cat has no mouse, no icons, and no graphics.

Raskin's goal at Apple had been to create a low-cost, minimalist "people's computer." However, as the Macintosh evolved into a product, it grew in scope, complexity, and cost. A year after his departure from Apple in 1982, Raskin founded a small company and began to design a machine that would recapture his original vision; he named the firm Information Appliance, a rather succinct statement of his utilitarian philosophy.

The company is still going strong. The Canon Cat is a refinement of the prototypes developed by Raskin and his coworkers at Information Appliance and is now being manufactured and sold by Canon U.S.A. under a series of technology licenses.

Ezra Shapiro is a consulting editor for BYTE. Contact him at P.O. Box 146069, San Francisco, CA 94114. Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

At First Glance

The 17-pound Cat takes about as much space as an Apple IIc with a monitor, standing $10^{11}/_{16}$ inches tall with a footprint $13\frac{1}{8}$ inches wide and $17\frac{3}{4}$ inches deep. The CRT display is tilted back from the keyboard at a comfortable viewing angle; the screen is slightly to the left of center. A 3½-inch floppy disk drive is mounted vertically next to the screen in the right-hand section of the integrated housing.

Outputs include a Centronics parallel port, a 25-pin RS-232C serial port, and two Telco RJ-11 jacks to connect the Cat's internal 300/1200-bit-per-second

continued

Photo by Paul Avis

IN BRIEF

Canon Cat

Company
Canon U.S.A. Inc.
One Canon Plaza
Lake Success, NY 11042-9979
(515) 688-7000

Size
$10^{11}/_{16}$ by $13\frac{1}{8}$ by $17\frac{3}{4}$ inches;
17 pounds

Components
Processor: 68000 running at 5 MHz
Memory: 256K bytes
Mass storage: One 256K-byte internal 3½-inch floppy disk drive
Display: 9-inch black-and-white built-in bit-mapped screen
Keyboard: Compatible with IBM Selectric typewriter plus control functions on front of key caps
I/O interfaces: One Centronics parallel port, one RS-232C serial (DB-25) port, and two RJ-11 jacks (one to external telephone, one to telephone line)
Modem: Internal 300/1200 bps

Software
Contained in ROM, it includes word processing, mail merge, calculation, communications, data retrieval, and programming in Forth or assembly language

Price
$1495

modem to an incoming telephone line and an external telephone. The modem uses the Hayes command set and can be configured either for regular ASCII communications (including auto-answer) or as a simple telephone dialer.

The machine's motherboard, boasting a 5-megahertz 68000 and 256K bytes of dynamic RAM, lies flat underneath the display. Software for the Cat is built into 256K bytes of ROM, with an additional 128K bytes that contains the system's built-in spelling checker, a 90,000-word version of *The American Heritage Dictionary*. Setup parameters and a small personal dictionary are stored in 8K bytes of CMOS RAM, backed up with a lithium battery.

Putting the Cat to Work

It's the software for the Cat that really shows off Raskin's conceptual touch. The basic interface is a simple text editor; you can sit down at the keyboard and just start typing. Initial defaults are set for a standard business page, so a novice can begin producing letters and memos almost immediately.

The Cat's full-size keyboard is almost identical to those of the IBM Selectric typewriter and its competitors. Although several new keys have been added to the layout, the business typist will notice no anomalies. The period and comma keys, for example, generate those characters in either shifted or unshifted mode.

While the tops of the key caps adhere to the office standard, computer commands are printed on the front face of many of the keys. The *L* key is marked Disk, the *J* key is marked Print, and so on. You trigger these special functions the same way you use Control-key combinations on a computer keyboard. However, the Cat's Control key is labeled simply Use Front—meaning use the command that is printed on the front of the key cap.

So, for example, to access the context-sensitive help screens (48K bytes' worth), you press the Use Front key together with the *N* key, which says Explain on the front of its key cap. A Setup command—the ¼ / ½ key—lets you change system parameters like margins, printer types, character set, and so on. An Undo command lets you reverse your last action.

The display looks as much like a typewriter with a sheet of paper as you can get on a CRT screen. Black characters on a white background extend upward from a white-on-black ruler bar at the bottom of the display. Margins are indicated with a hollow box superimposed on the ruler bar; the effect is similar to a typewriter's paper bail. Small symbols below the ruler show line spacing, justification, memory usage, and so on.

The Cat holds 160K bytes in RAM, which is roughly equivalent to 80 single-spaced typewritten pages. You move through your data by holding down one of two extra keys located in front of the spacebar and typing a string of characters; the Cat jumps to the next occurrence of that string. The right-hand key initiates forward searches; the left-hand key, backward searches. If the search string doesn't find a match, the cursor returns to your starting position. In Cat jargon, these two keys are called Leap keys.

Raskin claims that scrolling from the top to the bottom of a full 8½- by 11-inch page takes 8 seconds if you're pressing a cursor key, 4 seconds if you're using a mouse and scroll bars, and only 2 seconds with this Leap-key search mechanism. The disparity becomes more pronounced if you're trying to move longer distances with any precision.

Aborting a Leap operation is as easy as adding a few nonsense characters to the search string; the Cat won't be able to find it, and you'll be back where you started. Raskin suggests slapping your hand lightly in the center of the keyboard, an action likely to produce the required gibberish.

The Leap keys are also used to highlight text. You can delete, copy, or move highlighted blocks or check them for spelling mistakes with the built-in dictionary. If a highlighted block happens to be a mathematical formula, one keystroke calculates the result. The answer appears on the screen with a dotted underline; highlighting it and hitting a command sequence reveals the original formula, which you can then edit and recompute.

If the highlighted text is a computer program written in either Forth or 68000 assembly language, the Cat executes it. You can use a highlighted columnar table as the raw data for a full mail merge. Since you can assign sequences of commands mixed with text to each of the numeric keys at the top of the keyboard (accessed with the Use Front key), you can create complex macros or store boilerplate text.

One keystroke also dials a highlighted telephone number either for voice communications or to initiate a session with a remote computer; ASCII data simply flows into RAM as a long text document, which you can then manipulate as you would any other text. The incoming data stream is buffered in RAM, so if it doesn't require constant attention, you can move to another document and continue working.

Documents and Disks

The Cat environment is essentially one long text stream broken into pages. The software automatically inserts page breaks, but you can force a new page or start a new document whenever you want to. Forcing a document break resets a page-number counter to zero. Independent files do not exist per se, but if you don't want to use Leap searches to locate a specific document, the Cat lets you assign a title to any region started with a forced document break.

The machine uses a 256K-byte disk format, which holds the entire contents of the Cat's RAM plus configuration parameters, personal additions to the dictionary, system information, and a bit map of the last screen saved to disk.

There are several advantages to this system. First, you're always working in RAM, so you're always at full speed. Disk operations are reduced to swapping the entire load of RAM, which reduces

the risk of error. If you plug a disk into an idle Cat, it loads the contents of the disk, and you're ready to go. If the disk is unformatted, the Cat beeps at you: Executing the Disk command formats the disk and starts you off with a clean slate.

If you pull your disk out of the machine without saving, the Cat beeps. Insert the disk, and the Cat saves and continues. Insert a blank disk, and the Cat formats and saves your current RAM. Insert an already-used Cat disk, and the Cat beeps again, inquiring if you really want to erase it and save the current RAM; you have to hit the Disk key again to erase the disk.

Second, because each disk contains all configuration information as well as data, if you move a disk to another machine, you move your environment with you. You don't have to hassle with setting up parameters every time you switch Cats; that's all done automatically.

Finally, storing the image of the screen gives you the impression that load operations are extremely fast. It takes about 20 seconds to load a full disk into RAM, but only about 2 seconds to recall the screen data. Rather than waiting impatiently as the disk drive hums along, you're shown your work environment almost immediately, and you can use the remaining load time to figure out what you're going to do.

Low-Hassle Computing

The Cat represents an eye-opening new approach to data storage and retrieval; it will surprise anyone who thought that interface design was a dying art. Though the basic configuration appears on the surface to be a flexible word processor, the Cat's computational, macro, and programming capabilities make it quite possible to build data structures that emulate spreadsheets and databases.

The seeming formlessness of the environment may cause some initial hesitation if you are accustomed to the complexity and rigidity of current application packages, but it's easy enough to start small—with rudimentary typed documents—and graduate to more sophisticated operations as you need them. What's more, you've got the whole thing in a tidy package that clerical workers and executives alike won't find threatening.

Whether the Canon Cat is truly an "information appliance" is hard to say. Its $1495 price tag forces it into competition with low-cost MS-DOS clones and discounted Macintoshes—not a good position for a "people's computer." However, the Cat's unique interface could make it a strong contender; it's certainly worth a look, particularly if you're interested in low-hassle computing. ■

At last, real mainframe-based CAD power at a PC price.

Introducing MICRO CADAM CORNERSTONE™

Now you can have mainframe CAD power on your IBM® PS/2,™ PC/AT® or compatible—for just $2,995.*

If that sounds amazing, it is. Especially when you compare MICRO CADAM CORNERSTONE to run-of-the-mill PC CAD systems.

Use it to create complex orthographic drawings, then make automatic isometric projections with mathematical accuracy. It is a serious design tool, made to order for solving multi-dimensional problems, and solving them fast.

It employs the friendly CADAM user interface, famous throughout the industry for being easy to learn and use—even if you've never worked with a CAD system before. You can make drawings quickly and naturally, a feature you'll appreciate if you've ever struggled with an older PC-based drafting system.

MICRO CADAM CORNERSTONE is upwardly compatible with the whole CADAM family of CAD/CAM/CAE solutions, working today on more than 25,000 CADAM terminals and used by over 100,000 design and manufacturing professionals worldwide. And it features .DXF neutral files, so you can exchange data with other PC-based systems.

Everything you need is included: three-button optical mouse, comprehensive user guide, your own self-training course—and 60 days of free dial-up support from CADAM.

So if you want mainframe power with the affordable convenience of a stand alone desktop mechanical design system, start at the top—with new MICRO CADAM CORNERSTONE. At last, real mainframe power at a PC price.

To order, or for more information, call CADAM toll-free 800-255-5710.

MICRO CADAM CORNERSTONE . . . The Ultimate PC CAD Production Tool

CADAM INC

A SUBSIDIARY OF LOCKHEED CORPORATION

Circle 169 on Reader Service Card (Dealers: 170)

*Suggested U.S. licensing fee.

Dealer inquiries invited

Dick Pountain

The Archimedes A310

Probably the world's fastest personal computer, the Archimedes is also the first RISC machine inexpensive enough for home use

Editor's note: *The following is a BYTE product preview. It is* not *a review. We provide an advance look at this new product because we feel it is significant.*

At prices that start below £1000—approximately $1600—Acorn's new Archimedes is the first machine to offer reduced-instruction-set-computer technology to home users. Powered by the ARM (Acorn RISC machine) chip, the Archimedes comes in two series. The A300 computers are low-cost machines for school and home use that bear the name of the BBC, like Acorn's previous 6502-based BBC Micro. The A400 series, to be launched later this year, will feature fast hard disk drives, more memory, and expansion slots. The computers in the A400 series will be professional workstations.

Acorn's Archimedes

The machine Acorn lent me for this article was an Archimedes Model A310 (see photo 1) that features 1 megabyte of RAM and a single 3½-inch floppy disk drive. Its floppy disks have a capacity of 800K bytes. The A310 runs a new proprietary operating system called Arthur that provides some compatibility with the BBC Micro. Arthur is contained in the machine's 512K bytes of ROM, along with an advanced BASIC interpreter. A desktop-style interface is forthcoming.

The Archimedes supports color graphics with resolutions up to 640 by 512 pixels and as many as 256 colors from a palette of 4096. It also supports eight channels of stereo sound. It uses no custom hardware to support either the graphics or the sound; sound synthesis and blitting are done purely by "ARM power."

The machine comes standard with a parallel printer interface, an RS-423 serial interface (Acorn has used this standard in preference to RS-232C for years on the BBC Micro), outputs for composite monochrome and analog RGB video, and connectors for both stereo headphones and Acorn's proprietary Econet network. The computer also sports a three-button mouse.

Acorn offers three monitor choices for the Archimedes: a black-and-white monitor, a medium-resolution color monitor capable of 640 by 256 pixels in 256 colors (see photo 2), or none at all. The latter option lets you supply the NEC MultiSync or equivalent monitor that you need to use the highest-resolution screen mode (640 by 512 pixels in 16 colors).

The A310 sells in the U.K. for £875 with no monitor, £925 with the monochrome monitor, and £1075 with the color monitor. The A305, which in-

continued

Photo 1: *The Acorn Archimedes A310.*

Dick Pountain is a technical author and software consultant living in London, England. He can be contacted c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

cludes 512K bytes of RAM, costs £799 with no monitor, £849 with the monochrome monitor, and £999 with the color monitor.

The Hard Facts

The A310 is about the same size as an IBM PS/2. The 3½-inch floppy disk drive slopes so you insert disks at a slight downward angle, which is more natural for your hand. As soon as the drives are available, you should be able to upgrade to a second floppy disk drive for £125.

A detached 102-key keyboard follows the IBM Enhanced layout, although two or three keys have alternative names for compatibility with earlier Acorn machines (e.g., the End key is also called Copy). The three-button mouse plugs into a socket on the keyboard rather than on the system unit.

A single multilayer double-sided motherboard contains all the electronics, including four large JEDEC (Joint Electronic Device Engineering Council) carriers that contain the ARM and its three companion chips. Thirty-two RAM chips are hidden away under a metal bridge that supports the floppy disk drive. These are 64- by 4-bit devices, 16 soldered and 16 socketed (the latter would be empty on an A305). There is also a battery-backed 256-byte CMOS static RAM that the clock/calendar and the operating system use to store configuration parameters.

The motherboard contains a 64-pin bus-extender socket. This isn't an expansion slot per se; it's designed for an optional backplane board that holds two real expansion slots. Acorn calls the cards that fit in these slots *podules*. (The backplane is also used for a controller card if you add a hard disk drive to the A310.)

The podules Acorn plans to release include network cards (for Econet and Ethernet), ROM cards containing application software, a MIDI (musical instrument digital interface) sound card, an extended I/O card, an 80186 coprocessor to run IBM software, and a floating-point coprocessor.

The A300 and A400 machines diverge most sharply in the area of expansion. The A300 machines can accept only two podules (after you add the optional backplane), and they can't use coprocessors that need access to the system data bus. The A400 machines come with four slots, have Econet built in (thus saving a slot), and can accept coprocessors.

The A310 I previewed came with Acorn's medium-resolution color monitor, a straightforward analog RGB unit that connects to the Archimedes via a SCART socket (also known as a Euroconnector) and has the main controls and power switch mounted on the front. The color quality is excellent, but text definition is only adequate at 80 characters per line; it is somewhat better than an IBM CGA's text definition, but not as good as an EGA's. The Archimedes also supports 132-character text modes, but I found them too tiring for prolonged use; they might be usable on an NEC MultiSync or equivalent monitor.

A Designer Chip Set

The architecture of the Archimedes—a blend of simplicity and sophistication—depends heavily on three peripheral chips designed by Acorn specifically to complement the ARM. The ARM itself is a 32-bit RISC processor (see "How Much of a RISC?" by Phillip Robinson in the April BYTE and my "BYTE U.K.: The Acorn RISC Machine" in the January 1986 BYTE). Its design deliberately resembles a 6502 brought up to date with short, fast instructions and a superfast interrupt response time.

The three peripheral chips are IOC, the I/O controller; VIDC, the video controller; and MEMC, the memory controller. Along with the ARM, they are fabricated in 2-micron CMOS. By putting a lot of carefully chosen functionality into these three chips, Acorn has created a designer chip set to which you need add only RAM and disk controllers to make a computer. The chips are optimized to work together and to exploit the large processor-to-memory bandwidth better than an assemblage of off-the-shelf chips.

The IOC chip controls system interrupts and the system bus. It contains a number of timers, a serial keyboard interface, and logic for talking to peripherals like disk controllers and serial chips.

The VIDC chip contains 46 control registers and three 32-bit-wide first-in/first-out buffers for direct-memory-access transfer of video, sound, and cursor data. It can control a color display with 1, 2, 4, or 8 bits per pixel (i.e., from monochrome up to 256 colors) and with a colored border. It includes an on-chip 16-word color-lookup palette (allowing a choice of 4096 colors) and three on-chip D/A converters to directly drive the guns of an RGB monitor. VIDC supports a hardware cursor in any of three colors, and it permits programmable control over the VDU (video display unit) timing parameters, including an interlaced mode.

The pixel rate is programmable to 8, 12, 16, or 24 megahertz, which translates to a maximum of 640 by 256 pixels in 256 colors or 640 by 512 pixels in 16 colors. As an added feature, the 4 bits normally supplied to the red D/A converter are output on separate pins; external logic can serialize the bits to give a pixel stream four times the chip speed, or up to 96 MHz. Thus, with a suitable monitor, the VIDC chip can support a 1024 by 1024 high-resolution monochrome display.

The VIDC chip also supports sound synthesis, using a four-word FIFO buffer and an 8-bit latch driving a 7-bit D/A converter; sound signals are produced from the D/A converter output by integration and subtraction using external logic. The chip can handle from one to eight sound channels in stereo, and a dedicated VIDC register controls the stereo-image position for each channel.

The MEMC chip can address and refresh up to 4 megabytes of dynamic RAM, and it translates between logical

continued

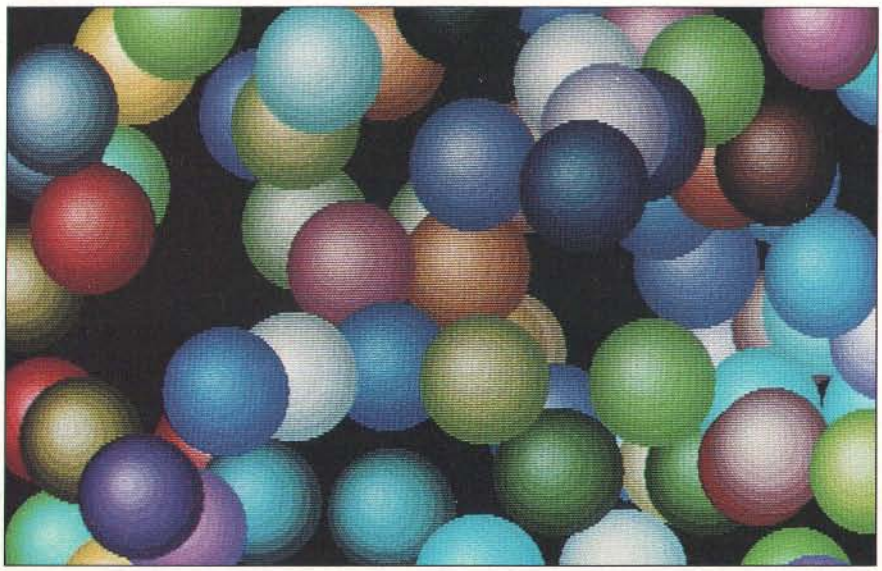
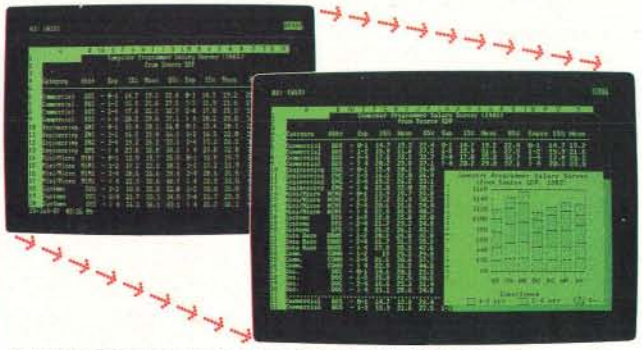


Photo 2: *An example of the Archimedes screen at 640- by 256-pixel resolution with up to 256 colors.*

Better Spreadsheets, Fast With Hercules.

Like to know a secret shared by nearly 200,000 Hercules RamFont users? Your 1-2-3, Symphony, Framework or Multiplan* will run better on a Hercules Graphics Card Plus or Hercules InColor Card.

And we run them better in a number of ways.



Hercules RamFont lets spreadsheets like 1-2-3 display nearly twice the data with no loss in scrolling speed.

Display More Data.

First, you get more data on the screen without sacrificing your ability to scroll or move around the spreadsheet fast. Hercules' exclusive RamFont mode lets 1-2-3 and Symphony display nearly twice as much data (from 2,000 characters to about 3,400) expanding your view from 80 columns x 25 rows to a full 90x38. Microsoft Multiplan's display expands from 80x25 to 90x30 with the ability to toggle between the two. And Ashton-Tate's Framework goes from 80x25 to 90x43.

More data on screen without a loss of scrolling speed means you get a more functional spreadsheet. And you get it fast.

Crisp Graphics. Mono & Color.

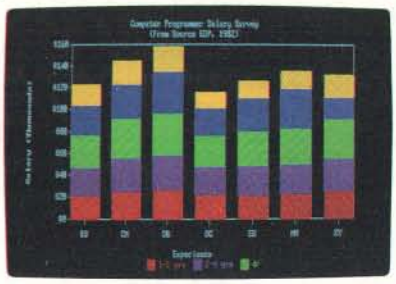
Hercules 720x348 graphics is the highest popularly supported resolution available for IBM PCs/XTs/ATs, and a wealth of compatibles.

Our industry-standard 720x348 graphics mode and RamFont mode are now available for both monochrome TTL monitors (Hercules Graphics Card Plus) and enhanced color "EGA type" and multi-synchronous monitors (Hercules InColor Card).

All of which means that built-in graphics on 1-2-3, Symphony, Framework II, SuperCalc 4, Javelin, Open Access, and Enable will be able to run in both mono and full color on either card. And so can add-on packages like Microsoft Chart, VP Graphics, and Stella Business Graphics.

Compatibility Plus.

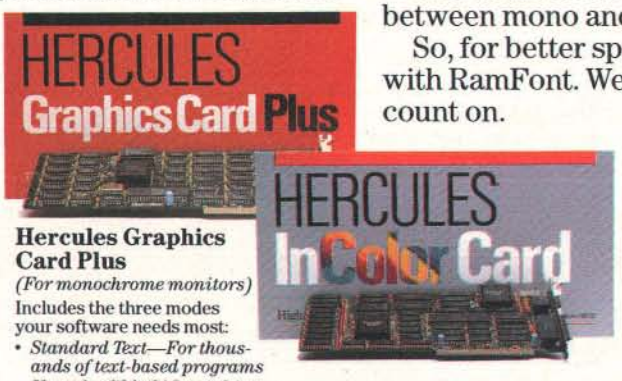
Which brings us to yet another big benefit for spreadsheets and graphics. Hercules cards are completely compatible with each other. Any monochrome standard text, Hercules graphics or Hercules RamFont compatible program (and there are thousands of them) will run in two to sixteen colors on the Hercules InColor Card without changing video drivers.



Hercules 720x348 resolution is now available in both mono and color for integrated or add-on graphics programs.

And that makes moving (or networking) between mono and color systems a breeze.

So, for better spreadsheets ask for Hercules with RamFont. We're the graphics cards you can count on.



Hercules Graphics Card Plus
(For monochrome monitors)
Includes the three modes your software needs most:
- *Standard Text—For thousands of text-based programs*
- *Hercules 720x348 graphics—highest popularly supported standard*
- *Hercules RamFont—3,072 software definable characters improve many popular software programs. (Call for the latest list.)*

Hercules InColor Card
(For multi-synchronous and enhanced color "EGA-type" monitors.)
Runs all Hercules monochrome software in 2 colors, most popular software in up to 16 colors selected from a palette of 64.
- *Standard Text—All programs run in 2 or more colors.*
- *Hercules 720x348 graphics in up to 16 colors—15% higher resolution than EGA.*
- *Hercules RamFont—3,072 software definable characters in 16 colors up to 12,288 in 2 colors.*

For more information call Hercules toll-free at: 1-800-532-0600 Ext. 304. In Canada, 1-800-323-0601 Ext. 304.

Hercules
We run your software better.

Circle 117 on Reader Service Card (Dealers: 118)

*Multiplan French and German version now available. English version available fall 1987.

and physical addresses to give a 32-megabyte logical-address space. It provides memory protection with three levels of access privilege: supervisor mode, operating system mode, and user mode. The MEMC also doubles as a DMA controller to manage the buffers for video, sound, and cursor data. Finally, it provides the processor-clock signal and all other system-timing signals; thus, it is the glue that holds the four chips together.

A Map of the Interior

In the Archimedes machines, the MEMC "sits" on the address bus, mapping all ARM 26-bit addresses into 22-bit virtual addresses and arbitrating between the ARM and the VIDC during DMA transfer for video, cursor, or sound data. The Archimedes has no dedicated video RAM; the screen buffer can exist in any portion of RAM (you can program its start address through the MEMC). None of the RAM needs to be dual-ported; the VIDC can always get DMA access to the screen by requesting it through the MEMC. The screen buffer is contiguous, not bit-plane-organized, and the VIDC simply groups adjacent bits together according to the color mode selected.

The MEMC supports page-mode memory access for greater speed when accessing adjacent addresses. A slow memory cycle sets the row and column addresses of the RAM. After that, fast cycles in which the MEMC only needs to alter the column address are permitted. Up to three fast cycles can occur before another slow cycle is required. The MEMC actually clocks the ARM at twin speeds: 4 MHz for the slow cycles and 8 MHz for the fast cycles.

When the MEMC receives a nonsequential-read request, it cancels the 8-MHz cycles. It always reads ROM at 4 MHz, which gives you a speed bonus for working in RAM. Since a large percentage of computer operations take place on sequential data (e.g., fetching most program instructions or moving a block of screen data), you can nearly double the effective throughput without using expensive static RAM. The DRAMs on the A310 I used had a 120-nanosecond access time. Since most ARM instructions execute in one cycle, the processing rate on mixed data probably exceeds 6 million instructions per second.

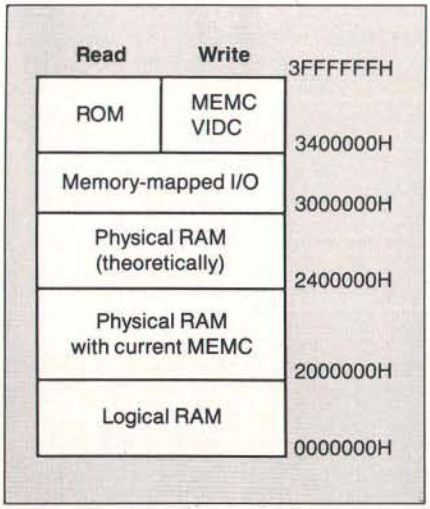


Figure 1: *Memory mapping on the Archimedes.*

The VIDC is optimized to take advantage of the MEMC's page-mode access. The VIDC loads video data into its FIFO buffer four 32-bit words at a time. For most video accesses, this means the first word transfers at 4 MHz and the next three at 8 MHz.

You can, in principle, use the MEMC to provide a disk-based, demand-paged virtual memory system, or to provide hardware memory protection for multitasking by stopping one task from interfering with another's memory. However, Arthur uses it more simply.

The ARM can address 64 megabytes with its 26-bit address bus. The MEMC maps this space as shown in figure 1. Only the bottom 32 megabytes of logically mapped RAM are available in user mode; all the higher addresses are restricted to supervisor and operating system modes. You can address up to 12 megabytes of ROM, of which the 512K-byte built-in operating system takes a portion. In principle, 16 megabytes of physical RAM could be present, but the current MEMC chip restricts this to the lower 4 megabytes (a limitation of the MEMC chip rather than the ARM).

The logical memory mapping provides great programming flexibility. The operating system can use addresses that are guaranteed regardless of how much real memory the machine contains. For example, the video-screen memory sits at the top of user memory (i.e., the thirty-second megabyte of the bottom 32 megabytes of logically mapped memory), and it grows downward as more is needed for the higher screen modes. This address remains the same on all models, from the 512K-byte A305 to the 4-megabyte A440. The system heap can allocate and reclaim pieces of memory from anywhere in physical memory, with no problems about loading order; contrast this with MS-DOS, where you can't reclaim freed memory stuck below a resident program without rebooting.

Operating With Arthur

Arthur is new but derives much of its design from the BBC Micro's 6502 operating system Acorn wrote in 1979. It is quite different from the CP/M and MS-DOS operating systems in philosophy.

For a start, Arthur segregates the machine operating system (MOS) proper from the disk filing system. The Archimedes comes with two alternative filing systems: the ADFS (advanced disk filing system), which supports both 640K- and 800K-byte floppy disk formats, and the ANFS (advanced network filing system), which supports file sharing via Econet. You change filing systems merely by loading a module from disk (i.e., type `ADFS` or `NET` at the MOS prompt).

Under Arthur, all files consist of a stream of bytes on the disk with no header; filename extensions are not supported. File-type information determines how Arthur treats a file; this information is stored not in the file itself but in 64 bits in the file's directory entry. Arthur uses these 64 bits in various ways. For executable binary files, they are two 32-bit addresses: the load address and the execution address. Programs can load and run from anywhere in memory, and many programs may be coresident.

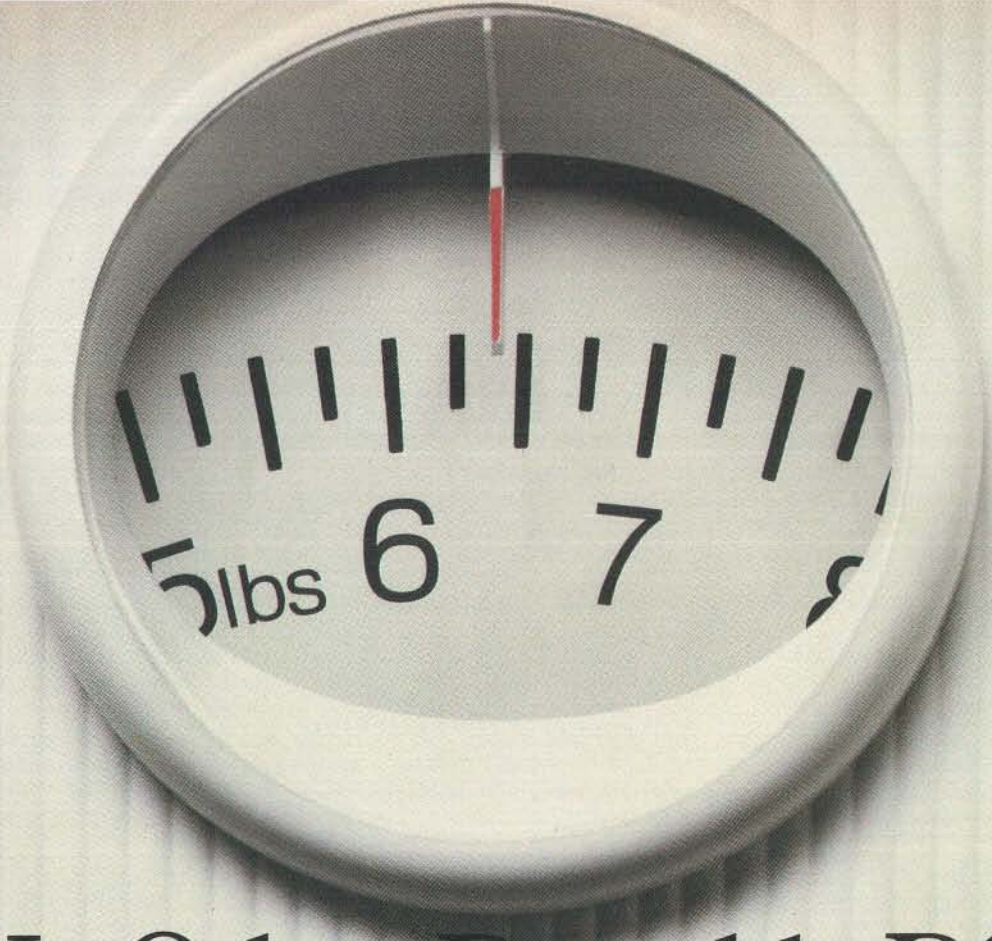
Although Arthur is not a multitasking operating system, the memory management scheme makes it easy to add multitask scheduling at the application level; Acorn's Twin editor uses this scheme to allow compilers to run in the background. Arthur also manages storage for graphics and sound data.

The command-line interface, which has an asterisk prompt, understands the same sort of commands as other operating systems, such as those needed to manage disk drives and files and support hierarchical directories like those in later versions of MS-DOS. The actual commands, however, are different, but you can change them to the familiar commands with a special `set alias` facility if you wish.

If command-line interfaces make you nervous, the Desktop front-end program conceals Arthur. For now, you must boot this program from disk. When it is finished, however, it will live in ROM. The Desktop looks like a cross between GEM and Windows. The copy I reviewed was in an early stage of development, but, even so, its response time was superior to the Macintosh's or GEM's, and it already lets you open subdirectory icons and launch programs by double-clicking. You can't yet pass parameters to a clicked program or pop desk accessories up from inside an application, but these and other features are coming.

The operating system also contains a powerful BASIC-like command language that you can use to create macros and new

continued



No Other Portable PC Can Make This Statement.

At 6.4 pounds, the new T1000 is the lightest portable PC in the world.

It's a good ten pounds lighter than some "portables." And you know how it feels to carry around ten extra pounds.

Yet within its diminutive footprint (it's about a foot wide and not even that deep) lies all the power of a desktop PC.

Included are 512KB of RAM and a built-in 720KB 3½" floppy drive, plus MS-DOS® 2.11 in ROM.

It comes with a new supertwist screen that's adjustable a full 180°, and folds flat when you want to add a CRT.

The IBM®-compatible T1000 offers you some very intelligent options. Like a numeric keypad and a 1200 bps Hayes®-compatible internal modem. Or an expansion card that will improve its memory by another 768KB.

All in all, it's the perfect way to go to work without going to work. Or to get home early, even when you'll be working late.

Call 1-800-457-7777 for the Toshiba computer and printer dealer nearest you. And see how it feels to pick up the most portable portable in the world. Nothing is as easy to take.

Except, maybe, its price.

In Touch with Tomorrow

TOSHIBA

Toshiba America Inc., Information Systems Division

Table 1: *BYTE BASIC benchmarks (times are in seconds); the Archimedes results are preliminary.*

	Write	Read	Sieve	Calculations
Archimedes A310				
ROM BASIC V	15.8	15.6	7.9	3.2
RAM BASIC V	15.8	15.6	6.0	2.4
Compaq Deskpro 386	25.0	24.0	21.0	6.8

Table 2: *BYTE C benchmarks (times are in seconds); the Archimedes results are preliminary.* [*Editor's note:* We have omitted the Float benchmark in C because the ARM C compiler essentially optimizes it to nothing.]

	Acorn Archimedes A310	Compaq Deskpro 386	Mac SE with HyperCharger
Fib	52.4	53.1	71.6
Sieve	5.7	6.0	14.9
Sort	10.0	5.6	20.6
Savage	91.2	21.5	8.8
Dhrystones per second	4901	3748	2176

Table 3: *BYTE C benchmarks that I have converted into BASIC V to find out what difference compilation makes (times are in seconds).*

	Fib	Savage
Archimedes A310		
ROM BASIC V	2868.4	45.5
RAM BASIC V	2174.1	32.8

commands and define environment variables.

The only thing I missed in Arthur was a good general-purpose system editor. The BASIC editor is powerful, but it can't open batch or text files. Acorn has a fast and powerful editor called Twin (so-called because it can split the screen into two windows), but you have to buy this separately as part of the Programmer's Toolkit.

A Welcome disk comes with the Archimedes; it contains the Desktop program, some tutorials, and a number of demonstration programs (including some games) that illustrate the power of the ARM. The Welcome disk also contains various utilities, like 65Arthur, a software 6502 emulator that lets many programs for the BBC Micro run on the Archimedes.

How Fast Is It?

Acorn claims that the Archimedes is the fastest personal computer in the world, which makes the task of benchmarking it more than usually sensitive. I ran the BYTE BASIC benchmark tests twice, once from ROM and once from RAM, because of the difference in access speed on this machine (see table 1). I ran the ROM set in ARM BBC BASIC V (the BASIC built into the Archimedes ROM). The RAM set used the RAM-resident version of BASIC V that comes on the Welcome disk.

I tested the BYTE C benchmarks (see "A Closer Look" in the September BYTE) using Acorn's ARM C compiler (see table 2). I also ran the Fibonacci and Savage benchmarks in BASIC V to find out what difference compilation makes (see table 3). While Fibonacci takes *much* longer in BASIC V, Savage runs twice as fast in BASIC V as it does in C on the Archimedes because the C compiler uses less efficient (but, at 64 bits, more precise) IEEE emulation routines.

The results suggest that Acorn's claim is not idle boasting, although, as with all benchmarks, there are wins and losses, and none of them tells the whole story. What I can say with certainty is that the Archimedes running C programs *without* a math coprocessor rivals the Compaq Deskpro 386, a 16-MHz 80386 machine *with* an 8-MHz 80287, and comfortably outpaces a Macintosh SE with a HyperCharger, a 15.67-MHz 68020 with a 7.83-MHz 68881, on all but the floating-point-intensive Savage benchmark (the Compaq also beats the Archimedes on the Sort). Even more remarkably, the Savage benchmark in interpreted BASIC V in RAM on the Archimedes takes only half again as much time as it takes in compiled C on the Deskpro 386 with a math coprocessor.

Benchmarks are not everything, but the experience of using the Archimedes tells me that on many untested tasks, like writing to the screen, it is far faster than anything else I've seen. If I had to take a stand on benchmark figures alone, I would look at the Dhrystone, which is the most general-purpose test (even though it doesn't test floating point). The Archimedes runs 31 percent more Dhrystones per second than a Compaq Deskpro 386.

It's a Winner!

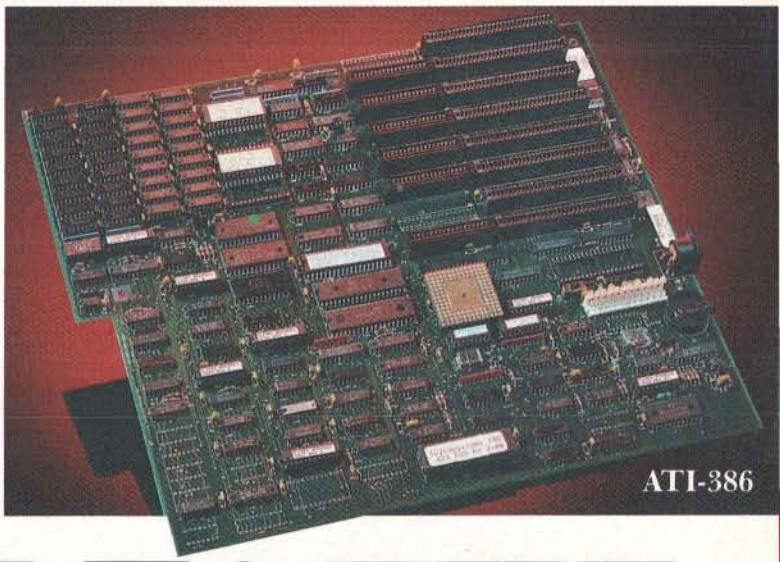
The Archimedes really does offer RISC power within the budget of the serious home user. What's more, it is extraordinarily inexpensive compared to its only serious competitors, the Macintosh II and the various 80386 machines.

The Archimedes really does offer RISC power to the home user. Its color graphics rival those of the Macintosh II and the IBM VGA, and they far exceed existing IBM standards. It's a boon to scientists and engineers who need to write their own high-performance software because it is no more difficult to program than the old Apple II. However, when provided with a hard disk drive and suitable applications, it also makes an excellent vehicle for desktop publishing and workstation roles.

Cynics can fairly point out that since the Archimedes lacks either an Intel or a Motorola microprocessor, it bucks the industry standards and lacks a software base. But there are times in computer evolution when you must make a quantum leap and leave existing standards behind to advance the technology; Apple did this when it came out with the Macintosh, and Commodore did it—rather less successfully—when it came out with the Amiga. I believe that the Archimedes is such an attractive hardware package—at such an attractive price—and so easy to write for compared to the Macintosh, Amiga, or Atari ST (thanks to its memory management hardware), that it will quickly promote a substantial base of software.

We should also remember that Acorn is owned by Olivetti, the most successful computer firm in Europe—and by no means negligible in the U.S., thanks to its deal with AT&T. The Acorn people have not finalized their plans for selling the Archimedes in the U.S., and it's not clear whose name will be on the machine when they do. The Archimedes is on sale now in the U.K., and you can get more information on it from Acorn Research Centre (5 Palo Alto Square, Suite 910, 3000 El Camino Real, Palo Alto, CA 94306, (415) 424-1114). I'm no Wall Street analyst, but my programmer's instinct tells me it's a winner. ■

We Deliver Advanced Technology



ADVANCE TO THE NEXT LEVEL

ATI-386

The ATI-386 AT board is a high-performance system board that provides the primary elements for building advanced personal computers. The board is functionally compatible with the system board in the IBM AT. However, it contains an 80386 microprocessor, 32-bit access to data and other features that give it over twice the performance of an 8MHz IBM AT.

Other features include downward compatibility with IBM 8 MHz AT, one MByte 32-bit on-board memory expandable to 16 MByte, a socket for the Intel 80387 math co-processor and more.

ATI-386-64

The ATI-386/64 Board features the same specifications as the ATI-386 AT board as well as on-board 64 KByte cache memory, cacheable to a full 16 MByte memory space to achieve nearly zero-wait state operation at full speed.

ATI-6/12 System 286

The ATI System 286-12 runs at an amazing speed of 12MHz. That's 20% faster than the IBM* Personal System 2 50/60.

And to protect your existing investment, we've built-in a normal-speed mode as well. A few simple keystrokes will switch you to 6MHz operation mode, when necessary.

Combine the ATI System 286-12 with our MegaGraph Plus EGA board to get superb graphics performance. Or expand your system's main memory with the ATI Multifunction card. Expand from single-user to multi-user system with up to five disk drive slots and eight expansion slots. 6/8 & 6/10 MHz systems also available.

12 MHz Multifunction Card

Our versatile multifunction card features a system bus of 12MHz. Sockets on board to handle up to 2.5 MBytes of memory, one serial port, one parallel port, one game port. Optional second serial port available.

Professional Image Board

The new Professional Image Board is a PC board which allows an ordinary home video camera (color or black-and-white) to be plugged into an IBM PC/XT/AT personal computers or IBM compatibles. Now, live, fast action scenes can be instantly captured in full color and frozen. The frozen pictures can be stored on a floppy or hard disk. The frozen pictures can also be transmitted to any remote computer in the world via modem or network.

ATronics International Inc.
We Deliver Advanced Technology
1830 McCandless Dr. Milpitas CA, 95035 USA
(408) 942-3344 **TLX:** 510-600-6093 **FAX:** (408) 942-1674

Southern California Contact: **CNT Marketing**
16580 Harbor Blvd., Ste. J, Fountain Valley, CA 92780 **(714) 839-3724**

Circle 23 on Reader Service Card

The American Success Story:

Basic System Features:

- 80286 16-Bit Intel CPU /• AT Style Keyboard
- 512K Motherboard Expandable to 1MB
- 8 Slots (2 8 Bit, 6 16 Bit)
- 1.2MB Floppy Drive
- Clock Calendar with Battery Backup
- 195 Watt Power Supply 110/220V Switchable
- Fully Compatible High Speed AMI BIOS
- Full 200 Page Users Guide in a Glossy Binder
- Limited One Year Warranty
- Fully Open Front Face Panel
- Our Systems are UL Approved

Option:

- 2 Hard Disk/2 Floppy Disk Controller /• 360KB Floppy Drive
- 1.44MB 3 1/2" and 720K 3 1/2" Drive /• Enhanced Keyboard

Dealers and Corporate inquiries are welcome

(415) 490-2201 FAX 490 2687 (24 HRS)

Tech Support Call (415) 683-6580

IBM AT. Xenix. AutoCad. MSDOS. PC DOS. Novell Network. Hercules. dBASE. Lotus. Sidekick. and Symphony are registered trademarks of their respective companies.

CLUB American Technologies has defined the standards for all other manufacturers. We provide the highest quality and finest workmanship in our products. We have the most qualified technical support and customer service in the country. Whether you are a corporate buyer or just want a reliable, made in the U.S.A. machine for yourself, call us and find out why we have shipped more than 25,000 machines all over the United State.

Call for our MAC Product

Corporate Buyer call for Corporate Desk
Dealers are welcome
University P.O.'s are welcome
Quantity Discount are available

Mon - Fri	7:30 — 6:30 (West Coast)
Mon - Fri	10:30 — 9:30 (East Coast)
Saturday	10:30 — 3:00 (West Coast)
Saturday	1:30 — 6:00 (East Coast)

CLUB

American Technologies, Inc.

3401 W. Warren Avenue, Fremont California 94539

Once upon a time, American led the world in innovation, quality, engineering, and manufacturing with names like Edison, Ford, and Bell...
Once Again America returns:

" If Imitation is the sincerest form of flattery, the CLUB 286 pays the IBM AT a heartfelt compliment. The only failing of the (CLUB 286) is that it imitates the IBM too accurately; ...and you can't beat that..."

Karl Koessel **PC World**
December 1986

Software Compatibility
Xenix, AutoCad, MSDOS, PC DOS, Novell Network, dBASE, Lotus, Sidekick, Symphony and others...

Monitors Optional

CLUB 286 8MHz Mono System $995

- **Basic System Features Plus**
- Fully Configured and Tested
- High Resolution 800 x 350, Hercules Compatible 132 Columns
- Monographics Card, Printer Port
- High Resolution 800 x 350 IBM Quality Monitor

Low Low Price

With a 20MB 1/2 HT 65ms Drive $1295
With a 30MB Full HT 39ms Drive $1495

CLUB 286 (12MHz Thruput) Mono System $1629

- **Basic System Features Plus** /• A 80286-10 CPU
- Fully Configured and Tested /• Hercules Compatible Graphics 132 Columns
- Video Adapter with Printer Port
- A High Resolution IBM Quality 800 x 350 Monochrome Monitor
- 2 Serials, 1 Parallel Port /• Wait State Insertible Slots
- 8/10 Keyboard Selectability /• 12MHz Thruput

With a 30MB Full HT 39ms Hard Disk $2129
With a 40MB 1/2 HT 39ms Hard Disk $2200
With a 80MB Full HT 23ms Hard Disk $2499

CLUB 286 8MHz EGA System $1399

- **Basic System Features Plus**
- Fully Configured and Tested
- High Resolution Micro EGA Card
- Capable of Mono, Color and EGA
- IBM Quality Monitor (EGA/CGA), 14" Nonglare Screen

With a 20MB 1/2 HT 65ms Hard Drive $1699
With a 30MB Full HT 39ms Hard Drive $1899

CLUB 286 (12MHz Thruput) EGA System $1995

- **Basic System Features Plus** /• 80286-10 CPU
- High Resolution 16 Color EGA Card with Mono and RGB Output
- High Resolution EGA Monitor, 14" Nonglare IBM Quality
- Wait State Insertible Slots /• 2 Serials/1 Parallel Port
- 8/10 Keyboard Selectibility /• 12MHz Thruput

With a 30MB Full HT 39ms Hard Disk $2490
With a 40MB 1/2 HT 39ms Hard Disk $2540
With a 80MB Full HT 23ms Hard Disk $2870

Circle 51 on Reader Service Card

12 MHz SPEED!

For your PC, XT, AT or compatible.

FastCACHE-286™

The *Fastest* PC Accelerator!

FastCACHE-286 is the fastest half card accelerator ever built. It is also the first to have an on-board 8088 socket, built-in high-speed 80287 clock, and software controlled slow and fast 80286 modes. FastCACHE-286 accelerates the IBM PC, XT and compatibles. It can be purchased in either a 9 or 12 MHz version starting at $399 (9 MHz). The card combines the best features of our 286TurboCACHE™ (*PC Magazine* "Editor's Choice") with the ability to run asynchronously. This frees it from the 7.2 MHz frequency barrier of synchronous cache cards and enables the board to run on dual-speed motherboards and PCs such as the Zenith 158 or the Leading Edge Model D! The board includes MicroWay's DCache software and is compatible with all PC software and EMS, EEMS, and EGA.

	SI	Sieve MS C (sec)	Shuttle Regen (sec)	Price
PC	1.0	5.88	100 (12)*	–
9 MHz FastCACHE-286	7.1	1.32	28 (7)*	$399
12 MHz FastCACHE-286	10.3	.93	22 (6)*	$599

*Times in parentheses are with an 8087 or 80287.

287TurboPLUS™

***Speeds Up* your 80287 *and* your 80286!**

287TurboPLUS adds a new feature to *PC Magazine* Editor's Choice – 287Turbo. 287Turbo increases 80287 speed from the 4 MHz used by IBM to 10 or 12 MHz. It has become an industry standard used in the AT, clones and the 386 Deskpro. 287TurboPLUS lets a user control the 80286 clock speed of the AT motherboard. Typical ATs will run up to 9 or 10 MHz. When used with 100 nsec DRAM and an optional high speed 80286 it is possible to get 11 MHz speed from an AT. 287TurboPLUS includes a 10 or 12 MHz tested 80287, 80287 diagnostic software and easily installs in your 80287 socket.

MICROWAY . . . Respected throughout the industry for high quality engineering, service and technical support.
Dealer, VAR, university and corporate inquiries are welcome.

MicroWay

The World Leader in 8087 Support

P.O. Box 79, Kingston, Mass. 02364 USA (617) 746-7341
32 High St., Kingston-Upon-Thames, England, 01-541-5466

Circle 181 on Reader Service Card

Steve Ciarcia

Part 2: Schematic

Build the Circuit Cellar AT Computer

Steve reveals the circuitry for his AT on a board

Last month, we took a close look at the structure of the IBM PC AT computer, and I introduced the highly integrated POACH (PC on a chip) set from ZyMOS that makes an AT on a board a feasible project. This month, you'll see that, aside from the choice of board layout and perhaps memory configuration, the task is done. [Editor's note: *You'll want to keep last month's article on hand. Many AT circuit details Steve talks about this month were described there.*] Since most functions are already part of the POACH set, the remaining circuitry must follow strict guidelines to remain 100 percent compatible. In essence, the rest of the design is just "cookbook" stuff and—as you can see from the circuit schematic for CCAT in figure 1—is fairly simple.

Inside CCAT

The CCAT is designed to run with either an 8- or 10-megahertz system clock, depending upon which 80286 chip is used (−8 or −10). POACH1 generates both PROCCLK and the system clock (SYSCLK) from a 16- or 20-MHz crystal connected across pins 26 and 27.

POACH1 requires a 32.768-kilohertz time base (CCROSC) for the 6818 clock/calendar/RAM. A CMOS 74HC04 inverter is used as the oscillator amplifier. The POACH1 6818 requires only 10 microamperes of standby current. Battery power for the 6818 is connected to pin 32 of POACH1.

The local data bus (D0 through D15) runs between the 80286, 80287, and POACH3-D. Local address lines A1 through A23 go directly to POACH3-A, but since the POACH2 memory mapper also generates A17 through A23 during direct-memory-access operations, those address lines are also connected to POACH2.

The system address bus lines SA1 through SA19 are generated by POACH3-A. Normally, CPUHLDA and ALE control system bus activity. +ACK from POACH2 gates SA17 through SA19 during DMA operations. SA0 is generated directly from A0 by POACH1. POACH1 also produces +CNTL OFF, XA0, LSDOE, MSDOE, and DT/R, which are required gate and direction control for the system data bus.

Memory-address and data-bus generation is a convoluted affair if you try to handle it with discrete logic, but it becomes straightforward for the CCAT project. POACH3-A generates the multiplexed MA0 through MA8 address lines that are controlled by +REFRESH and GA-2RAS. The memory data bus (MD0 through MD15) connects POACH3-D directly to the dynamic RAMs and ROM. XA0 gates the least significant byte; XBHE gates the most significant byte. -XMEMR and DIRMS control direction; when both signals are high, data flow is from memory to system.

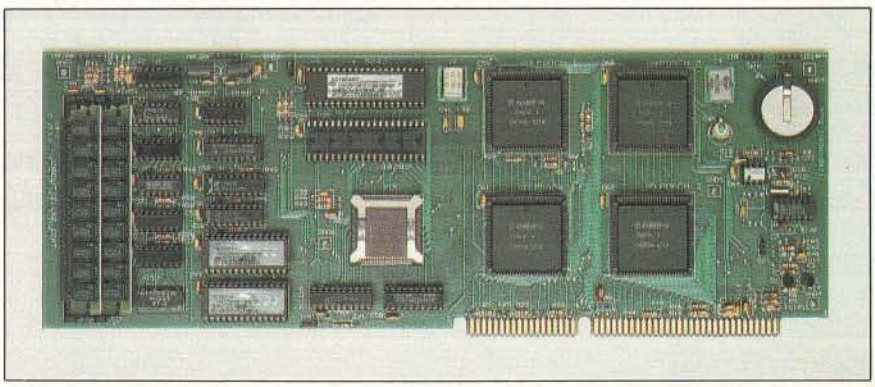
Primarily, the X address bus runs between POACH2, POACH3-A, and ROM. POACH2 generates -DMAAEN, which POACH3-A uses to control direction on the X bus during DMA operations. X data flows between POACH1, POACH2, the 8742 keyboard processor, and POACH3-D. DIR245 and -RDXDB control direction on the bus, and GATE245 and +ACK gate control the data flow.

The overall effect of integration on the AT is obvious when you view design complexity (including chip count) and board space. But some very subtle benefits don't immediately come to mind.

For instance, EMI (electromagnetic interference) and RFI (radio frequency interference) decrease dramatically. Every trace running across the circuit board is an antenna that radiates more ef-

continued

Photo 1: *The Circuit Cellar AT computer: an AT clone on a board.*



Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. The author of several books on electronics, he can be reached at P.O. Box 582, Glastonbury, CT 06033.

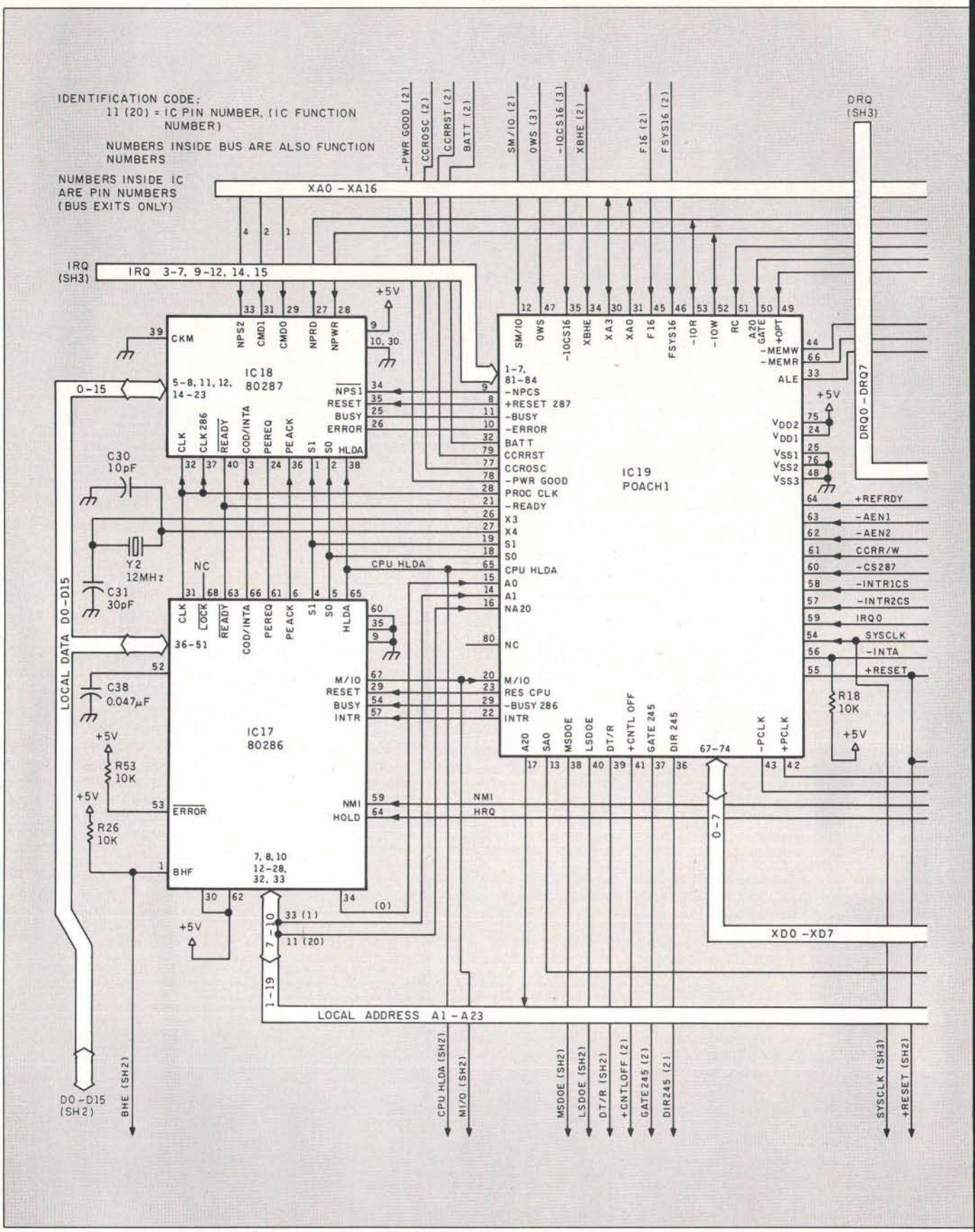
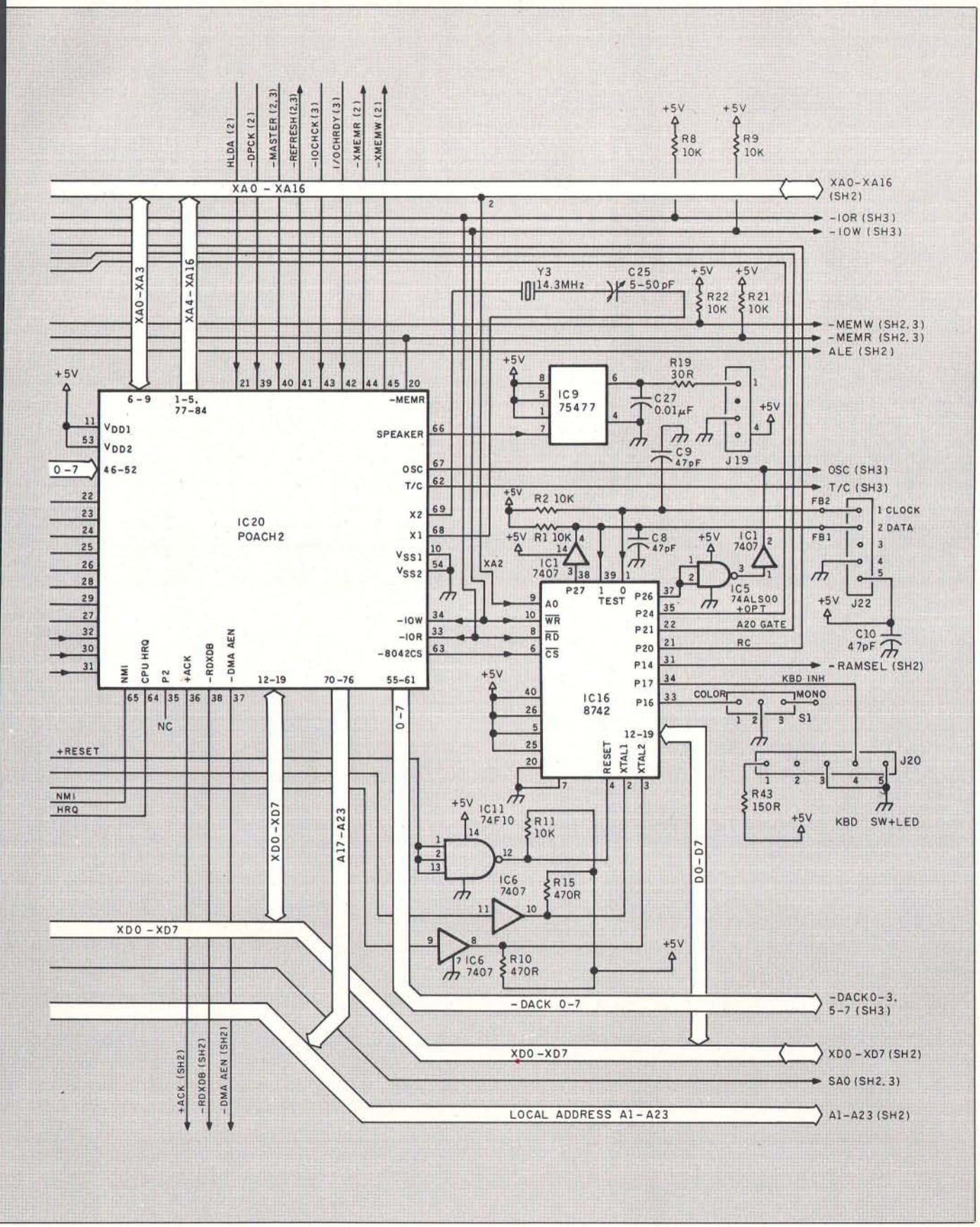


Figure 1: *The CCAT circuit schematic.*


HLDA (2)
-DPCK (2)
-MASTER (2,3)
-REFRESH (2,3)
-IOCHCK (3)
I/OCHRDY (3)
-XMEMR (2)
-XMEMW (2)
XA0 - XA16
XA0-XA16 (SH2)
-IOR (SH3)
-IOW (SH3)
XA0-XA3
XA4-XA16
Y3 14.3MHz
C25 5-50pF
R22 10K
R21 10K
-MEMW (SH2,3)
-MEMR (SH2,3)
ALE (SH2)
IC9 75477
R19 30R
C27 0.01µF
C9 47pF
J19
OSC (SH3)
T/C (SH3)
R2 10K
R1 10K
C8 47pF
IC1 7407
IC20 POACH2
FB2
FB1
1 CLOCK
2 DATA
IC5 74ALS00 +OPT
A20 GATE
RC
J22
C10 47pF
-RAMSEL (SH2)
IC16 8742
KBD INH
COLOR
MONO
S1
J20
R43 150R
KBD
SW+LED
+RESET
NMI
HRQ
NC
XD0-XD7
A17-A23
0-7
D0-D7
IC11 74F10
R11 10K
IC6 7407
R15 470R
R10 470R
-DACK 0-7
-DACK0-3, 5-7 (SH3)
XD0-XD7 (SH2)
SA0 (SH2,3)
LOCAL ADDRESS A1-A23
A1-A23 (SH2)
+ACK (SH2)
-RDXDB (SH2)
-DMA AEN (SH2)

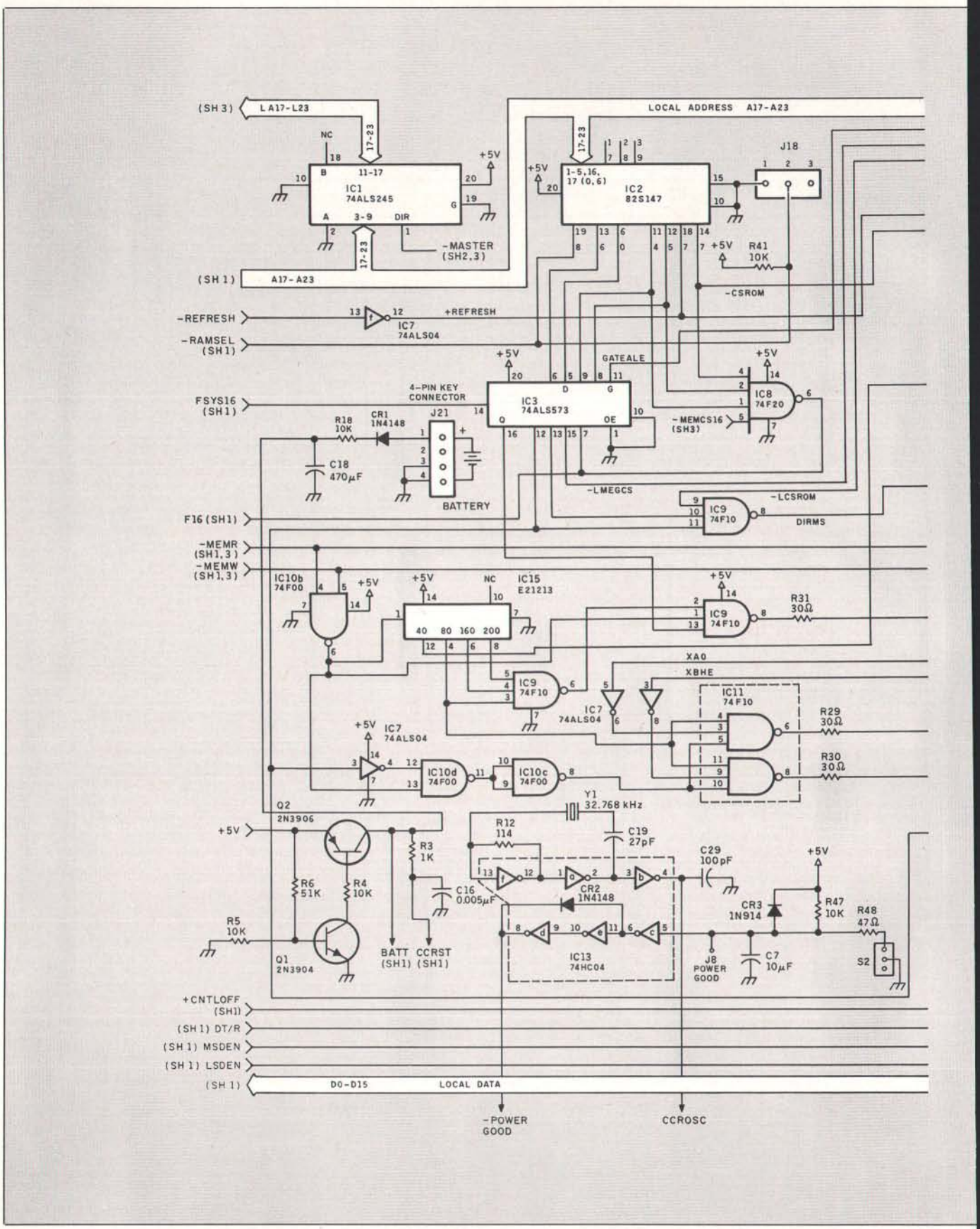
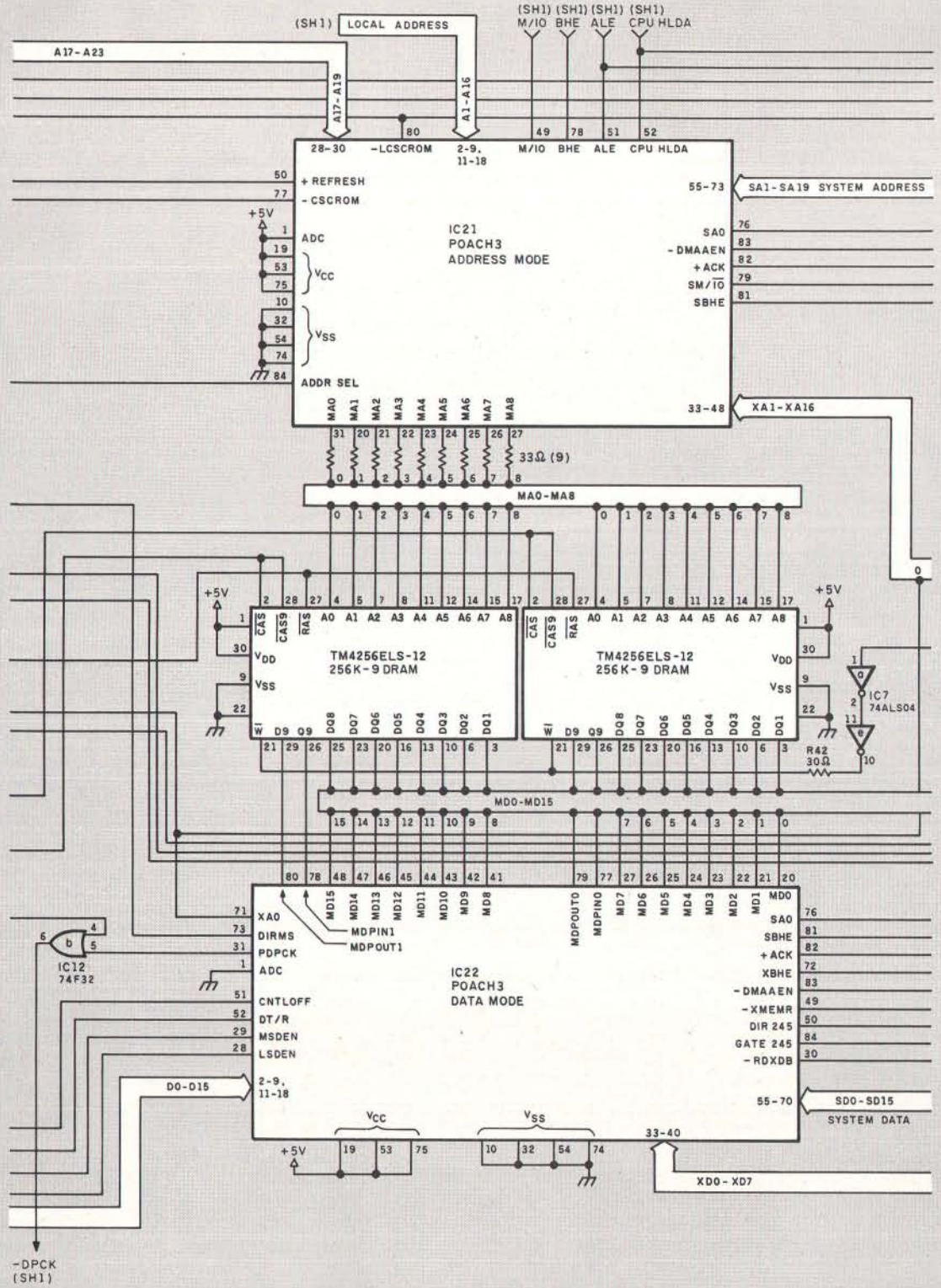


Figure 1: *Continued.*


(SH1) LOCAL ADDRESS
(SH1) M/IO
(SH1) BHE
(SH1) ALE
(SH1) CPU HLDA
A17-A23
A17-A19
A1-A16
28-30 -LCSCROM
2-9, 11-18 M/IO BHE ALE CPU HLDA
+ REFRESH
- CSCROM
55-73 SA1-SA19 SYSTEM ADDRESS
+5V
ADC
IC21
POACH3
ADDRESS MODE
SA0
- DMAAEN
+ ACK
SM/IO
SBHE
VCC
VSS
ADDR SEL
MA0 MA1 MA2 MA3 MA4 MA5 MA6 MA7 MA8
33-48 XA1-XA16
33Ω (9)
MA0-MA8
TM4256ELS-12
256K-9 DRAM
IC7
74ALS04
R42
30Ω
MD0-MD15
IC22
POACH3
DATA MODE
XA0
DIRMS
PDPCK
CNTLOFF
DT/R
MSDEN
LSDEN
MDPIN1
MDPOUT1
MDPOUT0
MDPIN0
SA0
SBHE
+ ACK
XBHE
- DMAAEN
- XMEMR
DIR 245
GATE 245
- RDXDB
55-70 SD0-SD15
SYSTEM DATA
33-40 XD0-XD7
D0-D15
IC12
74F32
-DPCK
(SH1)

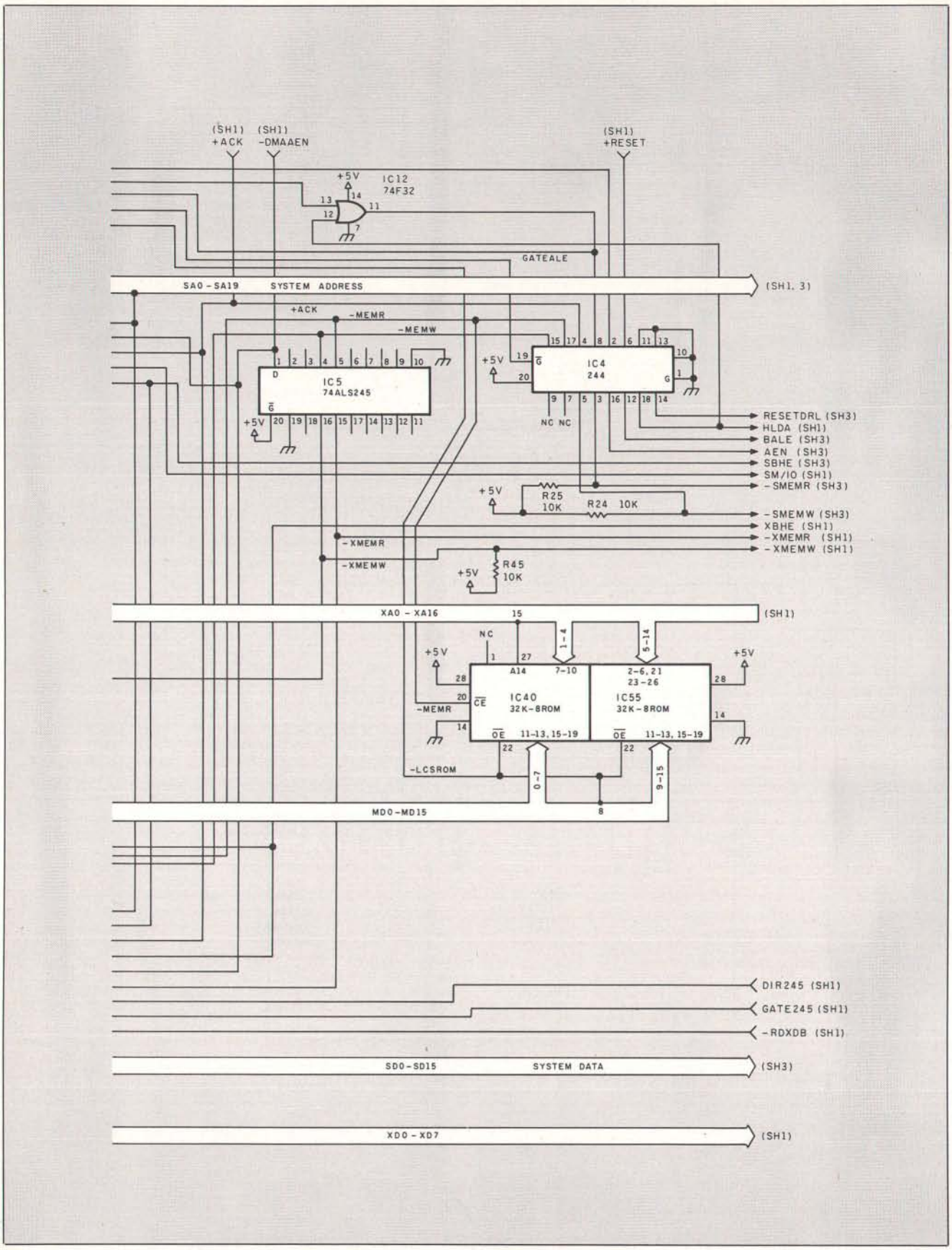


Figure 1: *Continued.*

fectively as the length increases, particularly if it becomes tuned to the carrying frequency. Integration collapses trace lengths, subsequently reducing emissions. Also, since the POACH set is CMOS, power requirements are substantially reduced. The original IBM PC AT motherboard drained 5 amperes. The CCAT requires less than 1 A (typically, about 0.8) at 5 volts.

The final configuration agreed upon for the CCAT was a six-layer printed circuit board with an AT expansion-board form factor: 4.8 inches high by 13.12 inches long (see photo 1). The four 84-pin packages in the center right portion of the board are the POACH chips. To their left are the three processors in the system: the 8742 keyboard controller, the 80287 math coprocessor, and the 80286 16-bit microprocessor. The Award Software ROM BIOS is located in the two sockets on the lower left portion of the board, labeled Low and High for low byte and high byte, respectively. The 16-MHz crystal, which provides clocking for the whole system, lies between the 8742 and POACH1.

Power, ground, system-address, data, and control signals are available at the edge connectors (see figure 2). These edge connectors follow the standard pinout of the IBM PC AT bus. The speaker and external backup-battery connections are located on the upper right edge of the card, immediately above the on-board battery. Both are 4-pin Berg strips with pin assignments, as shown in table 1.

A hardware clone of an AT is not considered compatible unless its operating system and application software also function in a manner equivalent to the way they would on an IBM PC AT. This compatibility is facilitated through the ROM and keyboard-controller BIOSes provided by Award Software for the CCAT. This licensed software is among the most efficient available to IBM PC–compatible developers.

One handy feature of the Award BIOS on the CCAT is that the Setup program usually provided on disk is built into the ROM. Invoking the Ctrl-Alt-Esc key sequence enters Setup where you can set the following options: date, time, diskette1, diskette2, disk1, disk2, video, base memory, extended memory, and error halt.

Putting the CCAT to Use

Even though it might be obvious at this point, I want to emphasize that the CCAT is the equivalent of the IBM PC AT motherboard. Like any AT motherboard, it needs other peripheral cards to function as a computer system. To create a system, you plug the CCAT and all the peripheral cards into a passive backplane (often called a passive motherboard) that carries all the signals from the CCAT to the other peripheral cards. (A passive backplane contains no circuitry—only connectors and connecting wires.)

Neglecting some of the new super-multifunction boards, a minimum CCAT system would require a display-driver card (e.g., EGA, CGA, and monochrome), an AT floppy disk or AT floppy/hard disk controller card, and a keyboard. For a complete system, you would add one more combo card containing memory expansion and serial and parallel ports. Thus, a full-function CCAT computer is made up of four cards. Visualize four expansion cards plugged into your present XT or AT, and you will see that it takes relatively little volume. That giant motherboard and power supply were hogging all the space!

I've already stated that the CCAT is both smaller and more power-efficient than a standard AT configuration. Being more efficient, it needs no power-supply fan or monster power supply (power requirements beyond the CCAT, of course, depend upon the specific peripherals you plan to use). Newly introduced VLSI display and disk-controller cards are also more energy-efficient as well.

In Conclusion

While the greatest audience for the CCAT design will eventually be OEMs looking for a better 80286-based computer, such testaments are relatively boring to an end user reading this article. Instead, to provide a suitable demonstration, it was only natural for me to consider making a briefcase-size, battery-operated portable computer as the conclusion to this project.

The CCAT is both smaller and more power-efficient than a standard IBM PC AT configuration. It needs no power-supply fan or monster power supply.

Unfortunately, like most computer systems these days, objective is not necessarily reality. I briefly considered building something to rival one of the commercially produced portable computers, but that was like trying to fit 10 pounds in a 5-pound bag. The CCAT does indeed reduce the size of the AT electronics to a point where such a project is conceivable, but standard form-factor peripheral cards, disk drives, batteries, a

continued

Table 1: *Speaker and external backup-battery pin connections.*

Pin	Speaker	Battery
1	Data out	Ground
2	Key	Not used
3	Ground	Not used
4	+5 V DC	6 V DC

Photo 2: *CCAT in a box.*

With the CCAT board, the only task becomes that of mechanically fitting off-the-shelf peripheral hardware in the smallest box.

display, and an AT keyboard just wouldn't fit in a briefcase.

Short of redesigning everything and making this portable computer a bigger project than the CCAT, I had to resort to using a larger case. Fortunately, I had this nice camcorder case sitting around holding an infrequently used camcorder. Out went the camcorder, and in went the CCAT and a bunch of other junk. Ten pounds eventually evolved into 30 pounds, with my minimal but efficient configuration losing out to enclosing everything but the kitchen sink. Equipment cases are like mass storage—the more room you have, the faster it seems to be filled.

My CCAT portable uses a backlit LCD, as most portables do. This $1395 display from Axonix Corp. (2257 South 1100 East, Suite 2C, Salt Lake City, UT 84106) has 640- by 200-pixel resolution and connects to the RGB output of a CGA display card, making it suitable for homebrew applications.

This display—and everything else in the unit—is powered from a pair of 4-A-hr 12-V gel-cel batteries (read that as *heavy*). The 12-V battery output is also converted to +5 V for the computer section and −12 V for RS-232.

The brain is a four-card AT system mounted on its side to reduce space. It consists of the CCAT board, a standard AT-style keyboard, an IBM CGA board, and clones of standard AT floppy/hard disk controllers and AST SixPakPlus expansion boards. Since we didn't know any better and nobody lifted the case until we finished, we added both a half-height floppy disk drive and a 40-megabyte hard disk drive.

There is nothing more I can add about this portable, beyond telling you what is in the case. With the CCAT board, the only task becomes that of mechanically fitting all this off-the-shelf peripheral hardware in the smallest box. We succeeded, and it works well indeed (see photo 2).

It operates for about 2 hours on the internal batteries, but it is better to plug it in the wall with the rest of the computers.

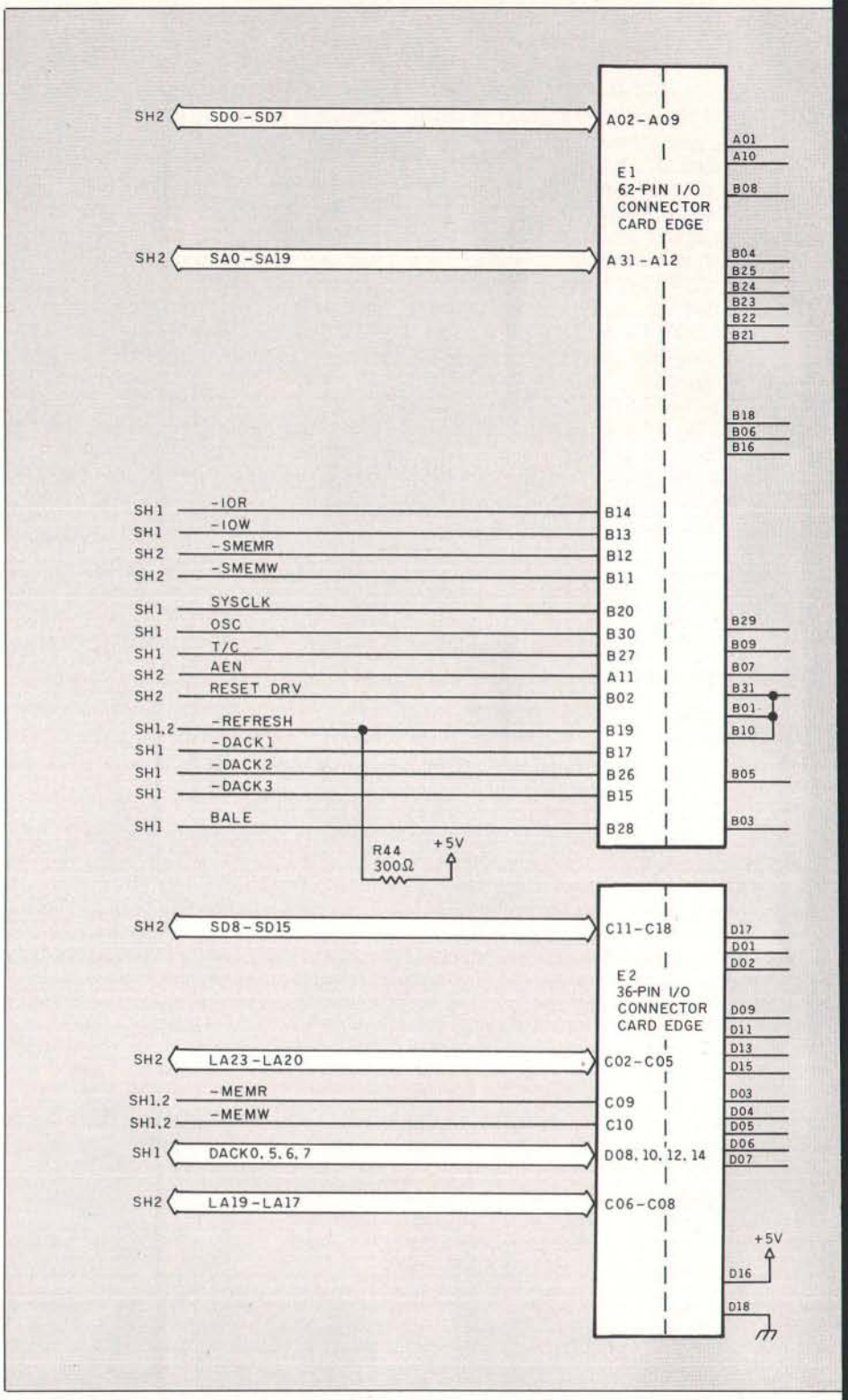


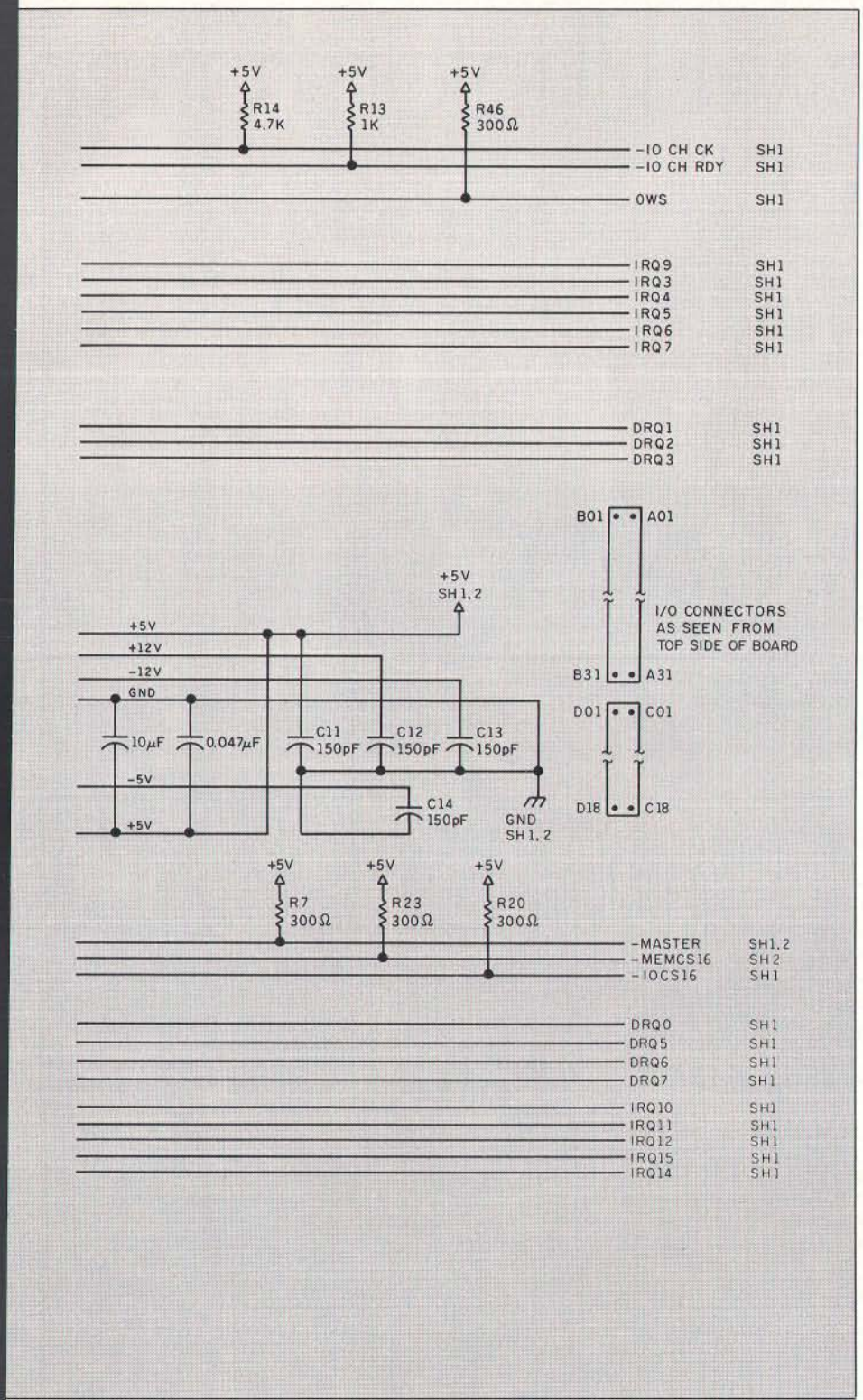
Figure 2: *Edge-connector pin-outs for the CCAT.*

And, while technically portable, it is a bit too large to use on your lap in an airplane. Still, it serves well as a transportable, and these 8088 portables are put to shame when you turn on the switch and crank up the CCAT's 10-MHz 80286.

Next Month

I'll begin a two-part project on how to build an IC tester. ■

The CCAT was a joint venture, and I'd like to note the contributions and help



from ZyMOS, Micromint, Award Software, and the Circuit Cellar research staff. In addition, I'd like to personally thank Bob Andrews, Jeff Bachiochi, Jeff Remmers, Steve Smith, and Charles Skyles for their efforts.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in book form from BYTE Books, McGraw-Hill Book Company, P.O. Box 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles in BYTE from September 1977 through November 1978. *Volume II* covers December 1978 through June 1980. *Volume III* covers July 1980 through December 1981. *Volume IV* covers January 1982 through June 1983. *Volume V* covers July 1983 through December 1984.

The following items are available from

Micromint Inc.
4 Park St.
Vernon, CT 06066
(800) 635-3355 (orders)
(203) 871-6170 (information)
Telex: 643331

1. Assembled and tested CCAT 80286 PC AT-compatible CPU board with 512K bytes of RAM, Award BIOS in ROM, and user's manual. Available in 8 MHz or 10 MHz.
   8 MHz, order OEM286LP/8 .....$775
   10 MHz, order OEM286LP/10 .....$825
2. Assembled eight-slot AT-style passive backplane with all connectors.
   order MBAT/8 .....$115

The following items are available from

CCI
P.O. Box 428
Tolland, CT 06084
(203) 875-2751

1. CCAT/POACH developer's kit. Contains six-layer CCAT PC board, four POACH chips, Award BIOS ROMs, preprogrammed 8742 keyboard controller, PROM, and user's manual. (This developer's kit is scheduled to be available through January 15, 1988.)
   order CCAT/DEV $475
2. Bare, unpopulated AT-style passive backplane PC board.
   order MBAT/0 ..... $35

POACH chips and BIOS ROMs are available. Call for price and delivery information.

For either source above, all payments should be made in U.S. dollars by check, money order, MasterCard, Visa, or American Express. Surface delivery (U.S. and Canada only): add $5 for U.S., $8 for Canada. For delivery to Europe via U.S. airmail, add $14. Three-day air freight delivery: add $10 for U.S. (UPS Blue), $25 for Canada (Purolator overnight), $45 for Europe (Federal Express), or $60 for Asia and elsewhere in the world (Federal Express).

There is an on-line Circuit Cellar bulletin board system that supports past and present projects. You are invited to call and exchange ideas and comments with other Circuit Cellar supporters. The 300/1200/2400-bps BBS is on-line 24 hours a day at (203) 871-1988.

To be included on the Circuit Cellar mailing list and receive periodic project updates and support materials, please circle 100 on the Reader Service inquiry card at the back of the magazine.

People who deal with "bauc of McGraw-Hill information

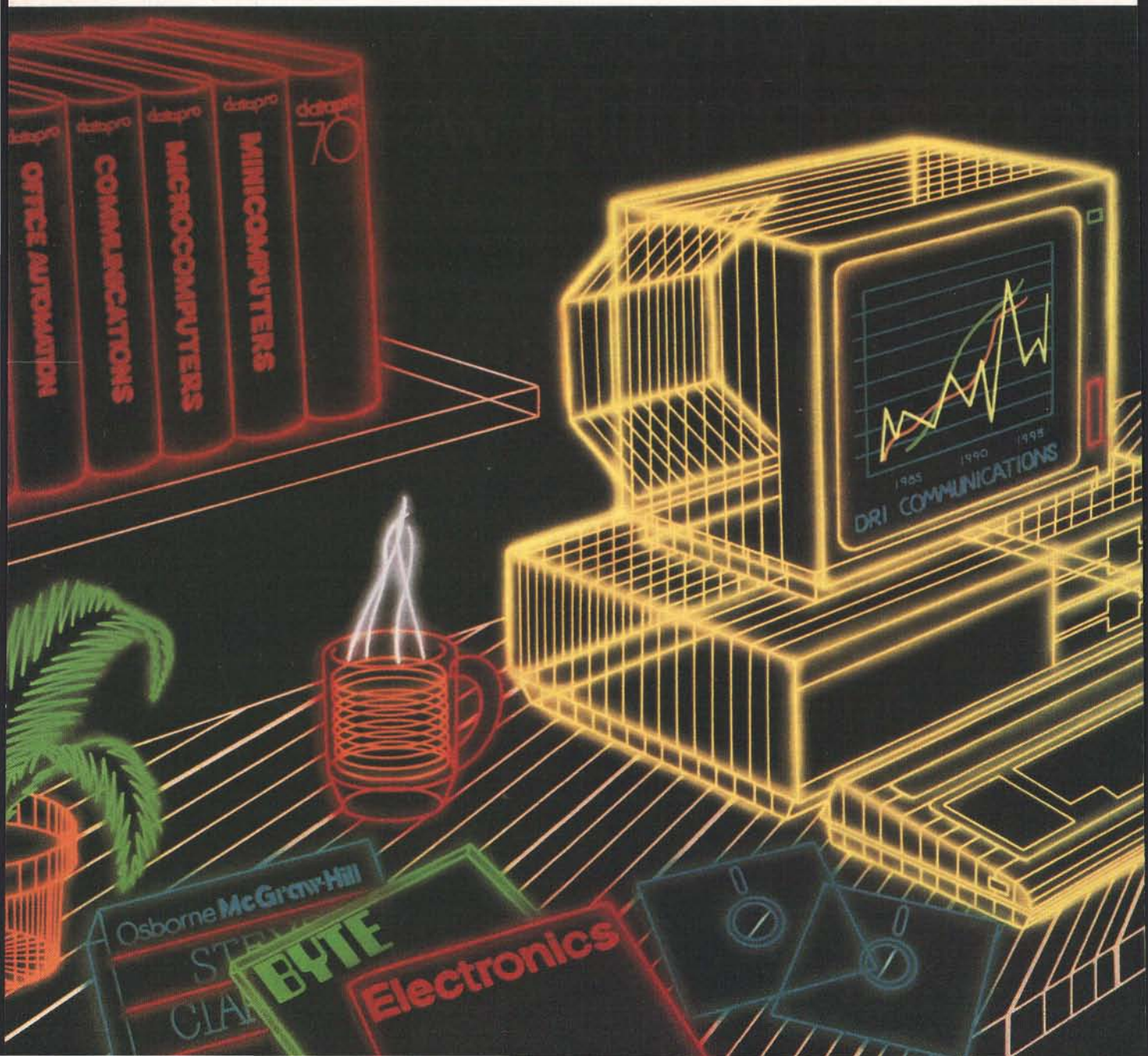
Nobody understands the value of good information better than the people who work in computers and communications.

And for those people, no information carries more weight than McGraw-Hill's. We provide the databases, analyses and news that computer and communications professionals rely on to illuminate the workings of their industries.

Everyone in the business keeps up with the latest developments by reading McGraw-Hill magazines. BYTE, Electronics and Data Communications are all required reading in the field. So are books fro Osborne/McGraw-Hill.

For MIS/EDP and communications professiona Datapro's print and on-line directories and reports cover every aspect of computer hardware and softwa from mainframes to micros, as well as communicatio and office automation.

For people who manufacture or sell microcomputers and microsoftware, Future Computing is the



and "byte" use every bit

umber one information source for product tests, nalyses and comparisons.

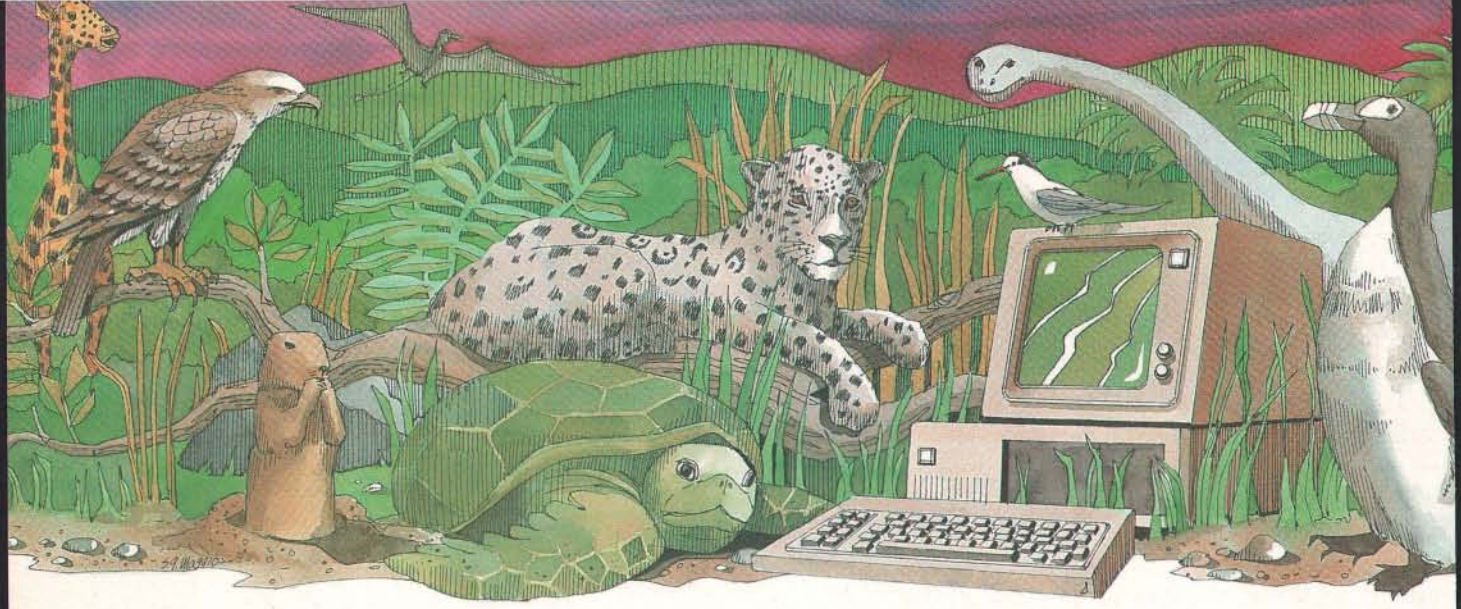
People who specialize in communications are ired into CCMI/McGraw-Hill, to receive not only the ard facts on communications tariffs, but also in-depth nalyses and bottom-line recommendations via print, oftware and on-line products.

And when telecommunications and computer ompanies plan for the future, they rely on DRI ommunications to provide them with forecasts of economic forces and industry trends.

When it comes to turning megabytes into megabucks, nothing computes like McGraw-Hill information.

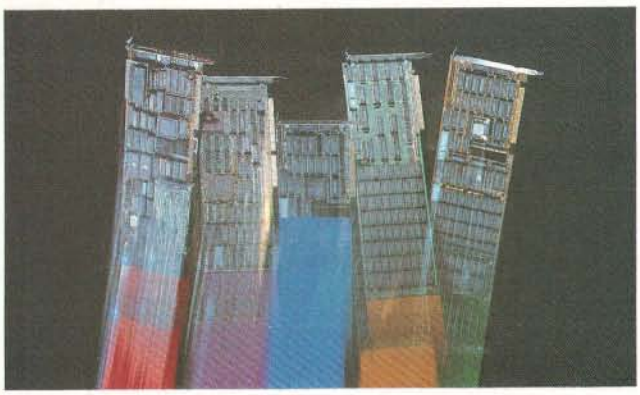
McGraw-Hill, Inc., 1221 Avenue of the Americas, New York, N.Y. 10020.

McGraw-Hill. Information that leads to action.



Is your PC an endangered species?

With PC technology evolving at breakneck speed, it's become survival of the fastest. But before you decide your PC, XT or even AT is doomed to extinction, take a look at PC Technologies' complete family of enhancement boards:



386 Express™ — Our 16-MHz 80386 accelerator — specially suitable for LANs — will make your IBM AT two to three times more productive *and* maintain full software compatibility including OS/2, all at a remarkably low price — $995.

286 Express™ — The first half-slot 80286 accelerator card and winner of AFIPS/FORTUNE Magazine's Hardware Product-of-the-Year Merit Award. Engineered to deliver two to six times more speed for your PC, XT or compatibles.

286 RAMracer™ — Two performance upgrades, one low price. Combines 8-MHz 80286 acceleration *and* up to 2MB of EEMS/EMS- compatible expanded memory for your larger, demanding software applications.

RAMpartner™ — Batter down the DOS 640K memory barrier with up to 2MB of expanded memory. Ideal for spreadsheets, databases, windowing software . . . and as a companion to the RAMracer or AST and Intel expanded memory products.

286 Rainbow Plus™ — Our one-slot, five-function board contains an Enhanced Graphics Adapter, a 10-MHz 80286 accelerator, *PLUS* a Microsoft® InPort™ mouse interface, parallel printer port, and clock/calendar.

To find out how easy — and economical — it is to take your PC off the endangered species list, see your nearest PC Technologies dealer. Or call us today, direct, at 800-821-3086 (outside Michigan) or 313-996-9690.

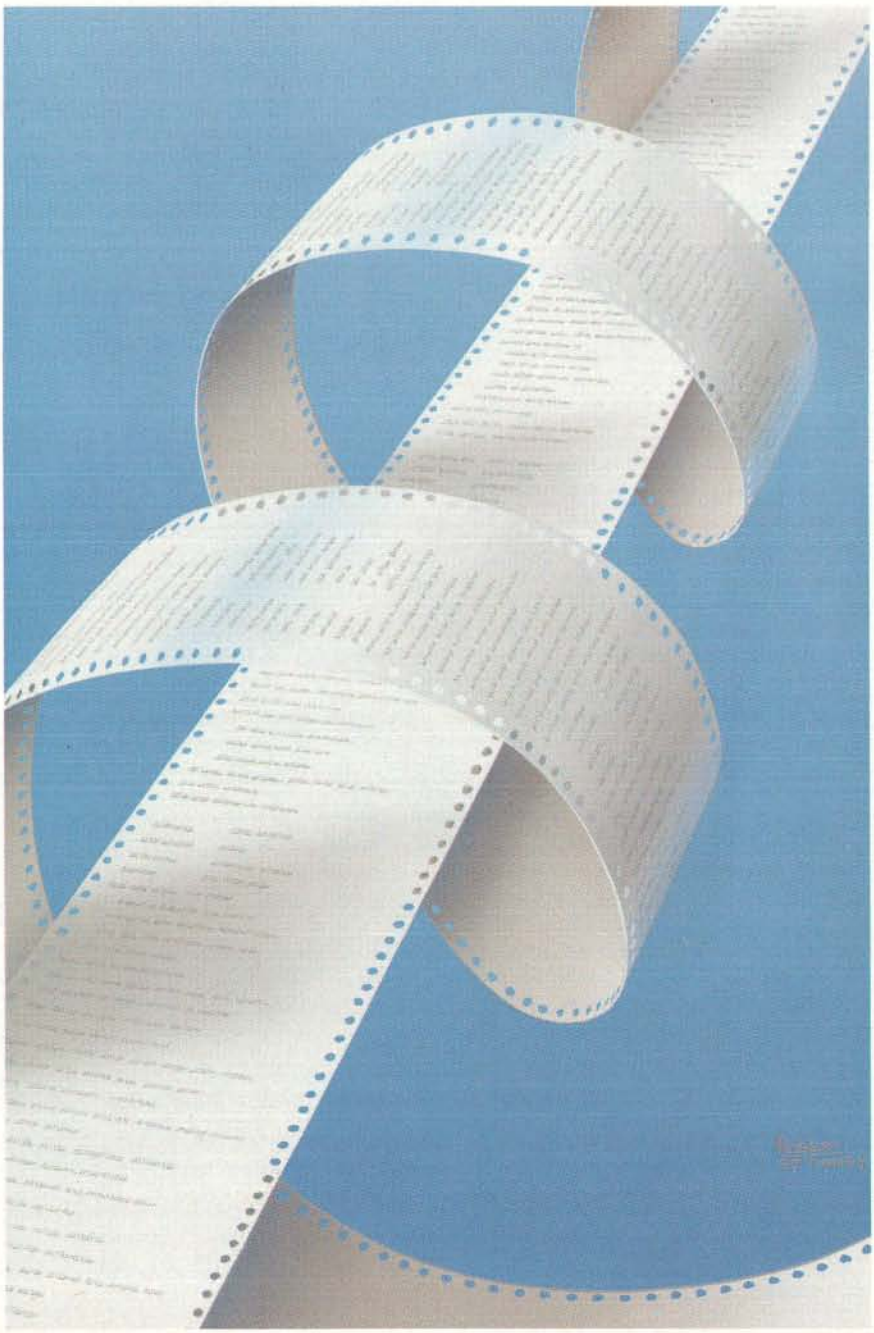
PCT PC Technologies Inc.

704 Airport Blvd., Ann Arbor, MI 48108
313-996-9690/Telex 503589/FAX 313-996-0082,
800-821-3086 (outside Michigan)

Trademarks: IBM PC, XT, AT, OS/2 — International Business Machines Corporation; AST — AST Research Inc.; Intel — Intel Corporation; Microsoft, InPort — Microsoft Corporation.

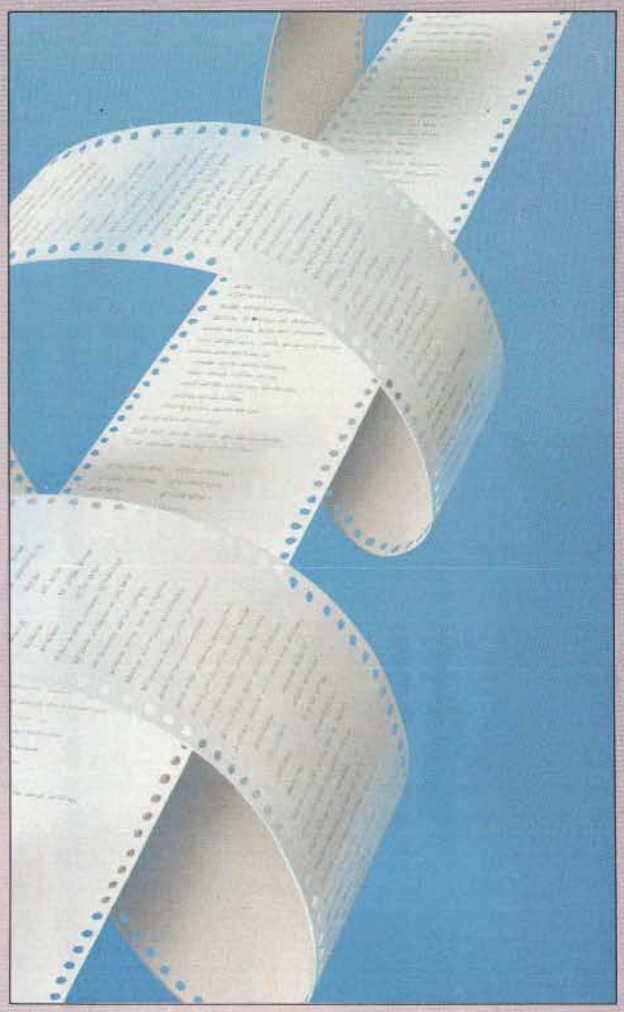
Circle 207 on Reader Service Card

Heuristic Algorithms



Introduction

Heuristic Algorithms



No matter how good a given algorithm is, it can't deal with problems it wasn't designed to solve, nor can it handle subtle variations of a problem. An algorithm, unfortunately, can only provide solutions to specific problems.

Heuristics can provide the capability to deal with the subtle variations in a problem, or to deal with a totally new problem, by devising a solution based on previous experience.

The synergy of these dissimilar methods of problem solving can provide powerful new tools to practitioners of artificial intelligence. A marriage of heuristic learning and algorithmic problem solving has already appeared in commercially available expert systems.

Heuristic algorithms have many potential applications. For example, computerized systems to design and control the manufacturing process, such as expert systems and other optimization systems, are becoming widespread. The problems solved by such systems (scheduling jobs, laying out workpieces, routing robots) are very often optimization problems of a combinatorial nature. Because these problems can be computationally very expensive to solve exactly, and because a solution must often be found in a real-time environment, heuristic rather than exact-solution techniques are frequently used.

One goal of ongoing research at Stanford University is to investigate methods for evaluating heuristic solutions to large-scale manufacturing problems. There are several combinatorially difficult manufacturing problems, including parts nesting, cutting-path determination, and machine scheduling. Since these types of problems are typically solved by a computer in real time, the "learning" power of a computer can be applied in a dynamic manufacturing environment.

In the following pages, we explore the emergence of some heuristic algorithms.

One of the most promising applications of machine learning to problem solving is in the embryonic field of neural networks. Neural networks were first conceived in the 1950s, but only lately have researchers successfully achieved results simulating these networks.

Two articles in this issue explore neural-network heuristic algorithms. Gary Josin gives an overview of general approaches to the heuristics of neural networks. William P. Jones and Josiah Hoskins closely examine the delta learning rule with back-propagation and offer a C-language program that demonstrates the technique.

Beyond neural networks, Paul V. Haley writes about the need for heuristic techniques in developing algorithms in Prolog. Haley explains the ways in which Prolog needs to be modified to permit *best-first*, instead of *depth-first*, searches.

Optimization problems constitute a category rich for the potential application of heuristic algorithms. Of particular interest is compiler optimization. Mark Roberts looks at this subject and speculates on the promise of heuristics in the development of microcomputer optimizing compilers.

The zero-knowledge-proof algorithm, developed recently by researchers at MIT; Berkeley; Haifa, Israel; and Toronto, uses a heuristic technique that Peter Wayner illustrates with a BASIC program.

Finally, we conclude our exploration of heuristic algorithms with Leon Sterling's examination of an equation solver written in Prolog that emulates the problem-solving heuristics of math students.

Although we may have only scratched the surface of this intriguing subject, we hope we've suggested the potential of the synthesis of heuristics and algorithms.

—G. Michael Vose, Senior Technical Editor

Zero-Knowledge Proofs

A new heuristic method lets you prove your identity without revealing a password or other information

Peter Wayner

RECOGNIZING THE DIFFERENCE between an authorized user and a fake is a difficult problems for computers. Traditional password systems and other heuristics for controlling access can never be made perfectly secure because a computer can judge only the signals it receives, not whether the binary bits are the product of a sincere, authorized user or of an impostor providing the same input.

Now, new mathematical techniques known as zero-knowledge proofs can strengthen these heuristic approaches by providing complex *interactive passwords* for users, passwords that cannot be faked by anyone who happens to intercept the message—or even by the host computer itself. The chief developers of the new methods are Oded Goldreich of Haifa University, Silvio Micali and Shafi Goldwasser of MIT, Manuel Blum of Berkeley, Charles Rackoff of the University of Toronto, and others (see reference 1).

Zero-knowledge proofs differ from regular mathematical proofs in two epistemologically curious ways: They hide the truth while defending its validity, and they are played out much like a card game. In a zero-knowledge-based exchange, the prover first makes an assertion. The skeptic verifies the assertion and specifies the next fact he or she would like to hear. The prover responds with another assertion. The exchange continues until the skeptic is satisfied.

What makes this ordinary-sounding interrogation process unique is that the individual assertions taken together reveal no privileged information *except* the fact that the prover isn't lying; the skeptic can safely conclude that the prover is indeed the person he or she claims to be.

A Preliminary Example

Arms-control treaties, because they are plagued by mistrust, are a good preliminary example for understanding how an interaction can hide information while providing some kind of validation.

Suppose a nation wants to prove it does not have nuclear warheads at a storage plant without revealing exactly how many conventional warheads it has stockpiled. In one zero-knowledge approach, the representative from the proving nation randomly divides the warheads between two locked rooms. The examiner from the skeptical nation flips a coin to choose one of the rooms. The prover hands the skeptic the corresponding key so he can check the contents of the selected room. If the skeptic doesn't find a nuclear warhead in the room, he can conclude there is only a one-in-two chance that the treaty is being violated.

The prover nation locks both doors, rearranges the warheads, and again lets the skeptic nation randomly select a room for viewing. After this examination, if no nuclear weapons are found, the skeptic concludes there is only a one-in-four chance that the treaty is being violated.

After 20 or 30 such iterations, the skeptic can be satisfied that even though he lacks absolute proof, the chance that he has chosen the wrong door every time is practically nil. Meanwhile, the prover can be content that the exact number of missiles hasn't been revealed.

This isn't a true zero-knowledge proof because it gives the skeptic a statistically converging estimate of the number of missiles. Nevertheless, it does illustrate several important facets of the method.

First, the techniques never prove something perfectly and incontrovertibly, but they always come as close as the two parties' patience will allow. This is a drawback for anyone who needs literal certification, but it should make no difference to practical people who realize how quickly 2^n shrinks. Second, zero-knowledge proofs keep the prover honest by letting the skeptic demand any particular fact, while hiding the entire truth from the skeptic by letting him or her choose only a fraction at most. Third, these proofs rely upon one-way functions to protect the information.

One-way functions are an important part of cryptography, enabling a person to encrypt information and place it in the open, secure in the knowledge that no inverse function can be found to decipher the information. In the warheads example, the one-way function is the random division of warheads between the two rooms. It is impossible to infer the total number of warheads from the number found in just one of the rooms.

In mathematics, one-way functions are operations that have no inverse, or at least no readily discoverable inverse. For in-

continued

Peter Wayner is a graduate student in computer science at Cornell University. He can be reached at the Department of Computer Science, Cornell University, Ithaca, NY 14853.

The security can be further strengthened by requiring that each prover be able to handle any of 1000 different x,y pairs.

stance, given a list of prime numbers, you can easily generate a product. However, the inverse operation—factoring—can be so time-consuming as to be impractical when the number is large—say, 100 or more digits. The public-key-cryptography system (see reference 2) relies on the difficulty of factoring large numbers.

Quadratic residuosity is another number-theoretic property that gives a good one-way function (see reference 3). I will use it in a program that demonstrates the operation of a zero-knowledge proof.

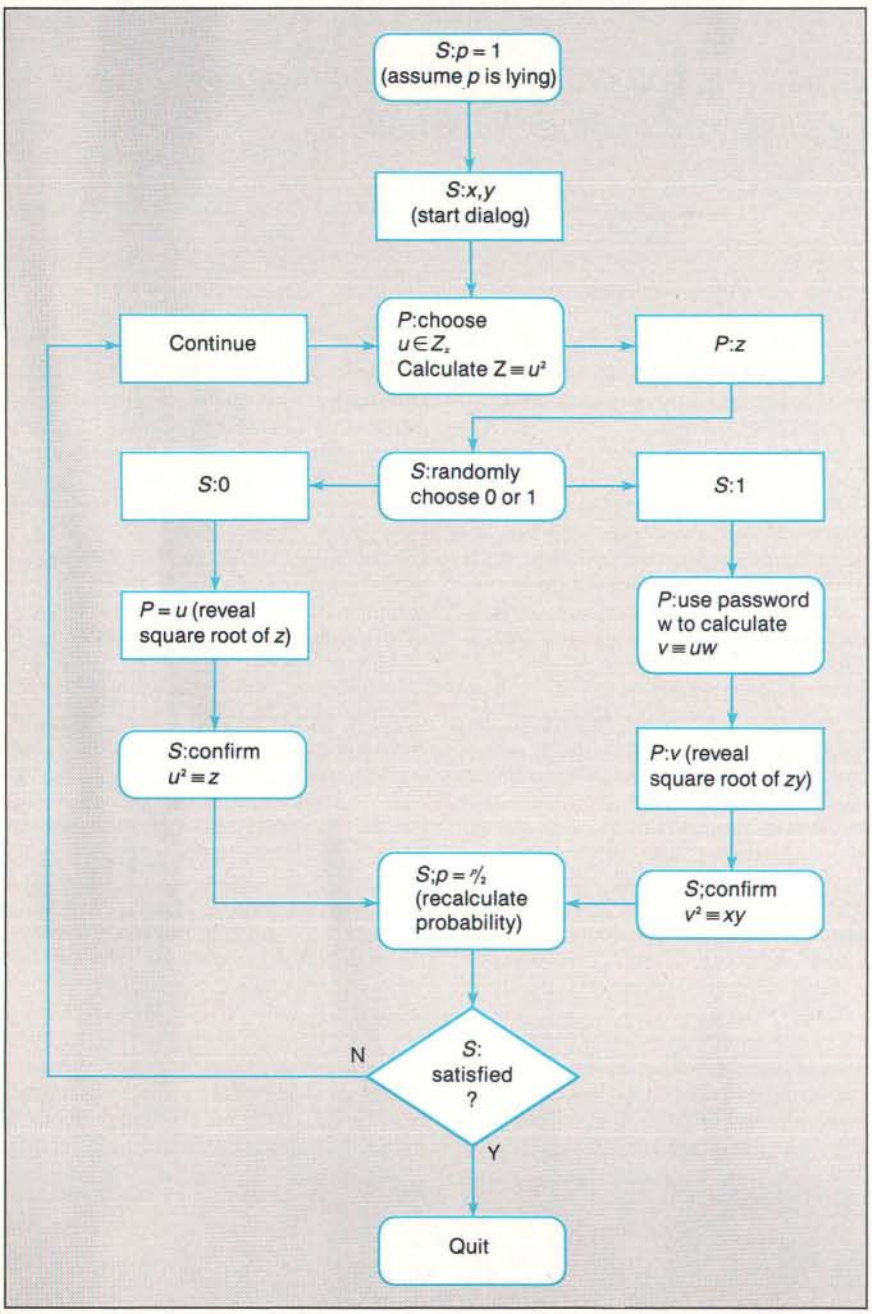


Figure 1: *Flow diagram of a zero-knowledge dialog between skeptic S and prover P. Squares indicate data revealed over the communications link; circles represent internal processing.*

First, we need some theoretical background.

Quadratic Residues

Given y relatively prime to x (i.e., x and y have no common factors except 1), y is said to be a quadratic residue of x if there exists a w such that $w^2 \bmod x = y$. For example, 9 and 10 are relatively prime, and $7^2 = 49 \bmod 10 = 9$, so 9 is a quadratic residue of 10.

For shorthand, let Z_x symbolize the set of integers relatively prime to x and QR_x symbolize the set of all elements in Z_x that are quadratic residues of x. For instance, $Z_{10} = \{1, 3, 7, 9\}$ and $QR_{10} = \{1,9\}$ since only those two numbers have square roots in Z_{10}: $1 = 1^2 \bmod 10 = 9^2 \bmod 10$, and $9 = 3^2 \bmod 10 = 7^2 \bmod 10$.

Quadratic residuosity makes a good one-way function because it is easy to square a number modulo x but difficult to find the square root of a number modulo x when the number is relatively prime to x and the factors of x are unknown.

Three other properties of quadratic residues are important here. First, the fastest way known to compute whether y is a quadratic residue of x is to start by factoring x into primes. Since this is hard when x is the product of large prime numbers (in excess of 100 digits each), a strong system must start with a very large x. The zero-knowledge interaction will also reveal nothing about the factors of x. Second, every $y \in QR_x$ has an equal number of square roots w such that $w^2 \bmod x = y$. The third property concerns products of two integers. If $y,z \in QR_x$ then $yz \in QR_x$; if $y \in QR_x$ but $z \in Z_x - QR_x$ then $yz \in Z_x - QR_x$. These facts can be proved using group theory or at least verified by working through a few sample cases.

A Working Example

In the working example, the prover is given x and y and asked to prove that y is a quadratic residue without revealing its square root. The square root is, in effect, the password, and the zero-knowledge techniques let the prover keep the password secret from the skeptic while still showing that he knows it. This prevents the password from being stolen by an eavesdropper.

Here is a more detailed view of the protocol. Keep in mind that all computations are done modulo x even when not explicitly so stated.

The skeptic S starts by giving the prover P the number pair (x,y). P will prove that he knows a square root w (i.e., $w^2 \bmod x = y$) without revealing what it is. P randomly selects u, a member of Z_x, squares it, and sends the result $z = u^2 \bmod x$ to S.

S then sends P a random bit, 0 or 1. If the bit is 0, P must reply with u, and S confirms that u is indeed a square root of the first number z. If the bit is 1, P uses the secret value w to form the product $v = uw \bmod x$, which he sends to S. S checks that this value is indeed a square root of the product zy. (Remember, $z = u^2$ and $y = w^2$ so $zy = u^2w^2 = vy$.)

In either case, P's correct response convinces S with a probability of ½ that P does know a square root of y. The process is repeated until the probability of cheating grows small enough to satisfy S. Figure 1 diagrams the process.

The technique works because it is not possible for both u^2 and u^2y to have square roots unless y is a member of QR_x. Since P doesn't know which he will be asked to provide ($\sqrt{u^2}$ or $\sqrt{u^2y}$), he cannot try to fake the choice of u. However, since P reveals only u or uw, it is impossible for S (or an eavesdropper) to derive a square root w of y from the information provided. Without a w, it is impossible to calculate a square root of u^2y, as required to satisfy S.

The BASIC program in listing 1 implements this system for the sake of demonstration. Both parties to the dialog are handled in separate routines of the program. The main program sets x and y, and then calls the two routines in turn using global variables to pass values between the two. A short routine, based on Euclid's algorithm, is used by both subroutines to test relative primality.

Several considerations are important to build a strong system. The first is making sure that x is large enough and has at most two factors (other than 1) of equal length. If x is prime, then the size of QR_x is $(x-1)/2$. If x is the product of primes p_1 and p_2, then QR_x has $((p_1-1)/2)((p_2-1)/2)$. (This can be proven with group theory.) Since every $y \in QR_x$ has the same number of square roots, it follows that each has only two or four square roots. This reduces the possibility of finding a square root simply by guessing.

The security of this system can be further strengthened by requiring that each prover be able to handle any of, say, 1000 different x,y pairs. The skeptic computer chooses a pair at random, and the prover must prove (in the zero-knowledge sense) that y is a member of QR_x. Having 1000 possible sets of quadratic residues adds deterrence by increasing the computational burden on any would-be intruder.

Of course, there are caveats to the particular zero-knowledge method outlined in this article, using quadratic residues. Its security relies heavily on the assumption that factoring numbers is too difficult to be done in a reasonable amount of time. If the numbers are chosen incorrectly, the system is not strong enough. Alternatively, if computer technology or mathematical theory advances sufficiently to make factoring a fast process, the quadratic residues method (and many more of today's encryption systems) will be vulnerable.

Practical Uses

Zero-knowledge proofs require a great deal of computation and thus are probably not adaptable to situations that rely

continued

A short routine, based on Euclid's algorithm, is used by both subroutines to test relative primality.

Listing 1: *A BASIC program, written in QuickBASIC, demonstrating the zero-knowledge-proof method using quadratic residues. A sample run is given at the end of the listing.*

```
RANDOMIZE
x = 100
DIM qr(100)
'qr(i)=0 if i is relatively composite to x
'      =1 if i is relatively prime to x
'      =2 if i is relatively prime and is a quadratic residue
FOR i = 1 TO x
  qr(i)=1
NEXT i
loop1:
  'Mark the primes and composites
  FOR i=2 TO x
    j=i
    k=x
    again:
      IF j MOD k = 0 THEN
        qr(i) = 0
      ELSEIF j MOD k = 1 THEN
        qr(i) = 1
      ELSE
        jj=j
        j=k MOD j
        k=jj
        GOTO again
      END IF
  NEXT i
loop2:
  'Mark the quadratic residues
  FOR i=1 TO x
    IF qr(i)>0 AND qr((i*i) MOD x)>0 THEN qr((i*i) MOD x) = 2
  NEXT i
start:
  'Select a y at random
  w = INT(x*RND)
  'Make sure it is a quadratic residue
  IF qr(w)=0 THEN GOTO start
  y = (w*w) MOD x
  PRINT USING "Prover: (Secret password w = ###)";w
  PRINT
  PRINT USING "Skeptic: (x,y) = (### , ###)"; x,y
  'x and y are global variables
  'w is known only to the prover
  'z,b,u,v are the four numbers exchanged
  'between the prover and the skeptic
  prob = 1 'Initial probability that prover is lying
  FOR try=1 TO 10
    PRINT
    PRINT "Round: ";try
    prover1:
      'Set n1=w^2 MOD x and n2 = y*w^2 MOD x
      'Randomly select a u in Z(x)
```

continued

```
      u = INT(x*RND)
      IF qr(u)=0 THEN GOTO prover1
      z=(u*u) MOD x
      PRINT USING "Prover: z = ##";z
    skeptic1:
      'Sees z and asks for square root of z
      'or square root of zy
      b=int(2*RND) 'b = 0 or 1
      Print using "Skeptic: b = #";b
    prover2:
      'Returns the correct square root
      IF b=0 THEN
        PRINT USING "Prover: u = ##";u
      ELSE
        v = (u*w) MOD x
        PRINT USING "Prover: v = ##";v
        END IF
    skeptic2:
      'Checks the prover's response
      IF b=0 AND (u*u) MOD x = z THEN
        PRINT "Skeptic: (u*u) MOD x = z: Ok."
      ELSEIF b=1 AND (v*v) MOD x=(z*y) MOD x THEN
        PRINT "Skeptic: (v*v) MOD x = (z*y) MOD x: Ok."
      ELSE
        IF b=0 THEN
          PRINT "(u*u) MOD x <> z"
          STOP
        ELSE
          PRINT "(v*v) MOD x <> (z*y) MOD x="
          STOP
        END IF
      END IF
    'Compute probability of lying
    prob=prob*.5
    PRINT "Skeptic: Probability of lying = ";prob
  NEXT try

run
Random Number Seed (-32768 to 32767)? 55
Prover: (Secret password w = 77)

Skeptic: (x,y) = (100 , 29)

Round: 1
Prover: z = 9
Skeptic: b = 1
Prover: v = 69
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = .5

Round: 2
Prover: z = 69
Skeptic: b = 1
Prover: v = 51
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = .25

Round: 3
Prover: z = 89
Skeptic: b = 1
Prover: v = 41
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = .125

Round: 4
Prover: z = 61
Skeptic: b = 0
Prover: u = 69
Skeptic: (u*u) MOD x = z: Ok.
Skeptic: Probability of lying = .0625

Round: 5
Prover: z = 89
Skeptic: b = 1
Prover: v = 59
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = .03125

Round: 6
Prover: z = 49
Skeptic: b = 1
Prover: v = 61
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = .015625

Round: 7
Prover: z = 69
Skeptic: b = 1
Prover: v = 49
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = .0078125

Round: 8
Prover: z = 89
Skeptic: b = 1
Prover: v = 9
Skeptic: (v*v) MOD x = (z*y) MOD x: Ok.
Skeptic: Probability of lying = 3.90625E-03

Round: 9
Prover: z = 21
Skeptic: b = 0
Prover: u = 11
Skeptic: (u*u) MOD x = z: Ok.
Skeptic: Probability of lying = 1.953125E-03

Round: 10
Prover: z = 49
Skeptic: b = 0
Prover: u = 93
Skeptic: (u*u) MOD x = z: Ok.
Skeptic: Probability of lying = 9.765625E-04
```

on human participation (such as the typing in of a password, or the response to a series of questions). However, in a world that is rapidly replacing paper with electronics, the zero-knowledge-proof method promises to be quite useful.

Banks, for instance, are heavily computerized businesses; increasingly, they rely on "smart cards" as a means of verifying customer identity. Under these circumstances, electronic eavesdropping can be as devastating to security and privacy as simply overhearing or glimpsing a password. The problem extends to communications between computers over the electronic networks that dominate the money markets; it is quite feasible for one computer to mimic another simply by "playing" the correct data stream. Zero-knowledge proofs may be able to help in these situations.

Zero-knowledge proofs will likely be a major factor in computer security systems of the future. ■

REFERENCES

1. Goldreich, Oded, S. Micali, and A. Wigderson. "Proofs that Yield Nothing but Their Validity." In *Proc. of the 27th Annual Symposium on the Foundations of Computer Science*. IEEE Publication, 1986.

2. Smith, John. "Public Key Cryptography." BYTE, January 1983, page 198.

3. Goldwasser, Shafi, and Silvio Micali. "Probabilistic Encryption." *Journal of Computer and System Sciences*, vol. 28, no. 2, April 1984.

Tandy Computers: Because there is no better value.™

The New Tandy® 4000

A price breakthrough in high-performance 80386 technology.

Put a Tandy 4000 on your desk and unleash the incredible power of the 32-bit, 16-megaherz 80386 microprocessor. The 4000 is so cost effective you can actually configure a 386 system for less than you'd pay for a competitor's 286 model.

The 4000 is ready to run current PC and AT® software with incredible new speed. And when new operating systems such as OS/2™ become available, the full potential of 80386 can be unleashed. When used with the XENIX® operating system, your Tandy 4000 can become the heart of a multiuser office system. Or configure the Tandy 4000 with a 3Com® workgroup file server to achieve maximum productivity.

A built-in, high-capacity 3½" disk drive lets you store up to 1.4 million characters on pocket-sized diskettes. Six AT slots and two XT™ slots give you plenty of room for system expansion. The Tandy 4000 also comes with serial and parallel ports, a 101-key enhanced keyboard, and a keylock with chassis-lock mechanism for system protection.

Come into a Radio Shack Computer Center and see the Tandy 4000—only $2599. (25-5000)

Send me a new 1988 computer catalog.

Mail To: Radio Shack
Dept. 88-A-24
300 One Tandy Center
Fort Worth, TX 76102

Name _____
Company _____
Address _____
City _____ State _____
ZIP _____
Phone _____

Radio Shack®
COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

Price applies at Radio Shack Computer Centers and participating stores and dealers. Monitor, display adapter and operating systems sold separately. AT/Reg. TM and XT/TM IBM. XENIX/Reg. TM and OS/2/TM Microsoft Corp. 3Com/Reg. TM 3Com Corp.

Circle 231 on Reader Service Card

Finally. A Portable Designed To Break The Mold, Instead Of Your Back.

Portable computers fit a predictable pattern. The more powerful they are, the less portable they are.

With one magnificently small exception. The T3100/20.

It's the best shape power has ever been in. A smaller, slimmer profile that's tailored to you, instead of the other way around.

Yet inside this sleek 15-pound package are 640KB of RAM and a built-in 20MB hard disk. All driven by an 80286 microprocessor, the same CPU that sparks the IBM® PC AT.®

Its gas plasma screen is so bright, it looks like a full-size CRT display. Which, by the way, you can easily plug into the T3100/20's standard RGB color port.

MS-DOS® 3.2 is standard. So are parallel, serial and 5¼" external drive ports. And a soft carrying case.

With every T3100/20, we'll include free copies of Lotus® *Symphony*®* and Lotus *Metro*,® two of the world's most popular programs, for the world's most popular portable computer.

You can also add a 1200 bps Hayes®-compatible modem, a five-slot IBM-compatible expansion chassis, 2 megabytes of extended memory, and a numeric keypad.

The T3100/20 is backed by Exceptional Care,** our promise that if we have to fix your computer, we'll fix you up with another one while you wait.

All of which leads one to a small dilemma. How to regard a machine that changes forever the way the world thinks about portable performance.

You could think of it as a desktop on a crash diet. Or the muscle of an AT without the bulk. Or simply as *PC World* put it: "A small miracle."

Call 1-800-457-7777 for the Toshiba computer and printer dealer nearest you. He can show you how to enjoy all the advantages of power.

With none of the burdens.

IBM & PC AT are registered trademarks of International Business Machines Corporation. MS-DOS is a registered trademark of Microsoft Corp. Lotus, Symphony and Metro are registered trademarks of Lotus Development Corp. Hayes is a registered trademark of Hayes Corp. *Limited time offer. **No-cost enrollment required. See your dealer for details.

In Touch with Tomorrow

TOSHIBA

Toshiba America, Inc., Information Systems Division

Back-Propagation

A generalized delta learning rule

William P. Jones and Josiah Hoskins

A CHERISHED DREAM of the computer age is to build machines that can think as we do. How closely must the computer's internal representations and processes resemble those of a person for this to occur? The wisdom of the artificial intelligence community has long been that a close resemblance is neither necessary nor, given the architecture of a conventional computer, feasible. However, some recent impressive successes of the neural-network approach to the production of intelligent behavior have forced a reconsideration of this position. Computer-based neural networks, for example, have learned to speak (see reference 1), to induce kinship patterns (see references 2 and 3), to recognize handwritten characters (see reference 4), and even to play games (see reference 5). Do these proof-of-concept demonstrations presage a breakthrough in efforts to build intelligent machines?

Implementations of neural networks, it turns out, date back to the beginnings of the computer age (see reference 6), and it has long been known that some of the earlier, more basic networks are severely limited in the kinds of computations they can perform (see reference 7). What, then, is new in neural-network research that might justify the current wave of excitement? Some of the resurgence of interest is a consequence of recent hardware advances in the construction of massively parallel machines that may enable much faster simulations of a biological neural network. Other theoretical developments may dramatically increase the computational power of neural networks—even when these are realized in a conventional Von Neumann machine.

This article focuses on one such development by Rumelhart and colleagues (see reference 8) (with similar developments by Parker [see reference 9] and Le Cun [see reference 10]) known as the *back-propagation rule*. This is a powerful, general learning algorithm employing a gradient- or "steepest"-descent heuristic that enables a network to self-organize in ways that improve its performance over time. We will examine the back-propagation rule and demonstrate its learning capability with a simple neural-network simulation implemented in C. But first, we set the stage by discussing the neural-network approach and some of the events leading up to the development of the back-propagation rule.

The Neural-Network Approach

The neural-network approach, also referred to as *connectionism* or *parallel distributed processing*, adopts a "brain metaphor" of information processing. Intelligent behavior in a person seems to emerge from interactions involving huge numbers of neurons—each of which, compared to a computer, is quite limited in its processing capabilities (i.e., with regard to its speed, the information it acts upon, and the information it produces). Similarly, under a neural-network approach, information processing occurs through interactions involving large numbers of simulated neurons, such as the one depicted in figure 1. This simulated neuron, or unit, has four important components:

- *input connections* (synapses), through which the unit receives activation from other units.
- a *summation function* that combines the various input activations into a single activation.
- a *threshold function* that converts this summation of input activation into output activation (e.g., perhaps 0 output activation if the input activation falls below some threshold).
- *output connections* (axonal paths) by which a unit's output activation arrives as input activation at other units in the system.

An inter-unit connection in a computer-based neural network is typically assigned a numeric weight that modulates the activation passing through the connection. If the connection from unit A to unit B has a weight of w_{BA} for example, then the activation output of unit A might be multiplied by this value to determine the activation actually received by B. We can then represent the absence of a connection between A and B by simply assigning w_{BA} a value of 0. An inhibitory

continued

William P. Jones (8200 Neeley Dr. #145, Austin, TX 78759) received his Ph.D. in psychology from Carnegie-Mellon University in 1982. Josiah Hoskins received his M.S. in chemistry from the University of Georgia in 1980 and is currently working toward a Ph.D. in chemical engineering at the University of Texas. Both are currently employed by Microelectronics and Computer Technology Corp.

A neural network's input, output, and internal state can all be characterized by the patterns of node activations.

relation between A and B can be represented by giving w_{BA} a negative value.

It is instructive to draw two important contrasts between the neural-network approach and a more conventional *rule-based* approach found in AI expert-system work:

- The knowledge of a neural network lies in its inter-unit connections and their weights. In contrast, much of the knowledge of an expert system lies in its rules (i.e., its condition/action or if/then pairs).
- A neural network is driven by the activation that passes from units to other units. In contrast, an expert system is driven by symbols generated as a consequence of rule-firing.

Because only numerically valued activation passes from unit to unit in a neural network, neural networks are often said to involve a subsymbolic level of computation. A network's input, output, and internal state can all be characterized by patterns of activation across its nodes.

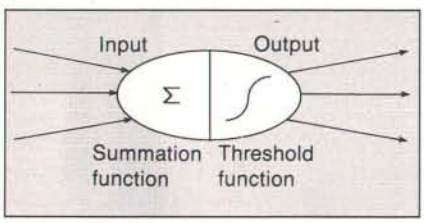


Figure 1: *A simulated neuron.*

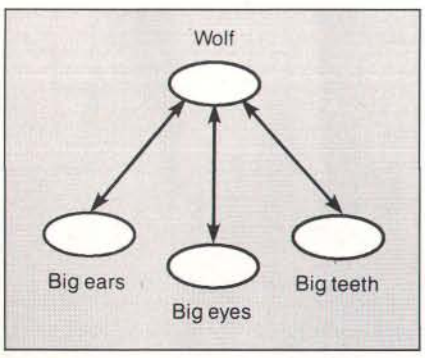


Figure 2: *A simple "wolf-detector" assemblage.*

How can intelligent behavior emerge from such very low level subsymbolic interactions among a network's units? It is sometimes helpful to view each unit as a classifier or a feature detector. Consider a simple example involving a tabula rasa Little Red Riding Hood who is sent to school to learn how to detect wolves in the forest. (Hopefully the school is not on the other side of the forest!) Little Red Riding Hood is shown a series of wolf pictures until she has internally formed the network depicted in figure 2. Input primitives in this example are the features of "big ears," "big eyes," and "big teeth." For each feature, there is a corresponding input unit with a rate of firing (i.e., an amount of output activation) that depends upon the extent to which this feature is detected in the outside world.

These input units, in turn, are connected to a unit corresponding to the "wolf" classifier unit. The actions of this unit's threshold function may cause it to behave like a Boolean AND so that it fires only when all three wolf features are observed. As the unit's threshold is lowered, it functions increasingly like a Boolean inclusive-OR, such that any combination of wolf-features is sufficient to trigger the wolf classification. It is through the combined effects of large numbers of such classifiers and input-unit feature detectors that intelligent behavior can emerge from a neural network.

The numerical base of the neural-network approach provides a ready means by which to represent continuous gradations in such things as the intensity of an input feature, the certainty of a classification, or the importance of a connection between two units. By contrast, such gradations are represented with great difficulty or not at all in most rule-based expert systems. Additional advantages of the neural-network approach may stem from properties of default assignment, content addressability, graceful degradation, and spontaneous generalization (see reference 11).

But how are the connections and connection weights of a network determined? As the size of a network increases, it is no longer feasible for the human designer to determine network connections by hand, nor is it feasible to engage the computer in a brute-force iterative search for the right connections. In a network with only a single layer of connections—those connecting input units to output units—there is a simple and elegant learning heuristic, the *delta rule*, that gives a network an ability to form and modify its own connections in ways that often rapidly approach a performance optimum. A brief discussion of the delta rule (sometimes called the Widrow/Hoff rule [see reference 12]) serves as an introduction to its recent successor, the more general and more powerful back-propagation rule.

The Basic Delta Rule

We describe the delta rule through the continuing education of our tabula rasa Little Red Riding Hood (LRRH). She will encounter three distinct beings in her world that we know as the wolf, the grandma, and the woodcutter. We limit LRRH to a single layer of connections between input nodes representing observable features and output nodes representing actions that LRRH can take. LRRH must learn to run away, scream, and look for the woodcutter when she detects a being with big ears, big eyes, and big teeth (the wolf). She must learn to approach, kiss on the cheek, and offer food to beings that are kindly, wrinkled, and that have big eyes (grandma). And she must learn to approach, offer food to, and flirt with beings that are handsome, kindly, and have big ears (the woodcutter).

Under these circumstances, the delta rule produced the network depicted in figure 3, with red lines corresponding to negatively weighted connections, and blue lines corresponding to positively weighted connections. Some features in the network have more diagnostic value than others (e.g., "big teeth" versus "big eyes"). However, LRRH need only correctly identify two features of a being in order to produce an appropriate set of actions using the network in figure 3.

The training procedure used in conjunction with the delta rule to produce the network in figure 3 is straightforward. There are three I/O training pairs, one each for the wolf, grandma, and the woodcutter. An input pattern I is represented by a vector of 0s and 1s that follow the ordering of input nodes in figure 3. Thus, the input pattern for the wolf is {1 1 1 0 0 0}. The target output pattern T that we want LRRH to produce in response to an input pattern can be similarly represented. Thus, the target output pattern for the wolf is {1 1 1 0 0 0}. Before training begins, connections between all input nodes and all output nodes are formed, and each connection is randomly given a small, initializing weight.

Training using the delta rule then proceeds by cycling through the training pairs until a satisfactory level of performance is reached. On a given trial, the network first generates an output pattern O_p in response to the input pattern I_p of a training pair. The discrepancy, or delta, between the actual and the desired behav-

continued

COMPATIBLE WITH IBM® PS/2™

Mitsubishi Diamond Scan.™ The New Standard In Multi-Application Monitors.

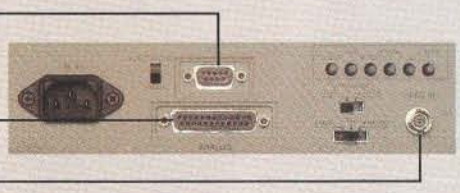
Introducing Model AUM-1371A—The Single Solution Monitor Ideally Suited For Applications Ranging From Monochrome Text To Full-Color, High Resolution Graphics.

Introducing the newest, most versatile high resolution color monitor in the industry today—Mitsubishi's Diamond Scan (Model AUM-1371A).

Actually five monitors for the price of one, the Diamond Scan delivers everything you'll ever need in a multi-application monitor. Including full compatibility with the IBM® PGC/EGA/CGA/MDA and Monochrome Hercules graphics boards. And for even greater flexibility, the Diamond Scan also accepts NTSC video input.

Exceptional design characteristics allow for a resolution up to maximum 800 horizontal dots and maximum 560 vertical lines on a 13V″ viewing area. What's more, Mitsubishi's Diamond Scan incorporates proprietary auto-scan circuitry which automatically locks onto any horizontal frequency from 15.6KHz to 35.0KHz, and any vertical frequency from 45Hz to 75Hz.

Other advanced design features include a high resolution CRT with .31 dot pitch, automatic screen image adjustment, super-high contrast panel glass for improved visibility and Diamond Matte® coating for maximum glare reduction. All packaged in a compact, ergonomically styled plastic cabinet.



Move up to Mitsubishi's Diamond Scan—the new standard in performance and versatility by which all others will be compared.

For additional information and the location of your nearest distributor, call Mitsubishi today at 1-800-556-1234, Ext. 54. In California, call 1-800-441-2345, Ext. 54. Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502.

NEW!

Graphic Board Compatibility*

☑ Quadram QuadEGA ProSync	☑ STB EGA Multi Res
☐ Orchid Turbo EGA/Turbo PGA	☑ Everex Micro Enhancer
☐ Sigma Designs Color 400	☐ Hercules
☐ Video 7 Vega-Deluxe	☑ IBM VGA, PGC, EGA, CGA
☑ QDP VIVA 640/800/1000	☐ AST Research AST-3G/Model 1
☐ Paradise Auto SW EGA	☐ ATI Graphics Solution/EGA Wonder

*Partial List Only

We've Got A Great Picture In-Store For You.

MITSUBISHI ELECTRONICS

Circle 183 on Reader Service Card (Dealers: 184)

ior of the network is then determined by subtracting vector O_p from the target output pattern T_p of the training pattern. Under the delta rule, the post-trial change in the weight w_{ji} of a connection between input unit U_i and output unit O_j is a function of the activation I_{pi} of the input unit and the delta $(T_{pj} - O_{pj})$ associated with the output unit. Specifically,

$$\Delta w_{ji} = n(T_{pj} - O_{pj})I_{pi} \qquad (1)$$

where n represents a trial-independent learning rate. (As the learning rate increases, so too does the risk of oscillatory behavior.)

The delta rule essentially assigns credit (or blame) to the input units according to their activation levels; the more active an input unit, the more responsible it is (or should be) for the current distribution of activation among output units. The effect, then, is that connections pointing from the more active input units of a trial will undergo the largest modification in their weights. At the same time, among connections pointing from a given input unit, the larger modifications will involve those connections that point to output units with larger associated deltas (i.e., discrepancies between actual and target activation levels).

It can be shown that the delta rule belongs to a class of gradient- or steepest-descent heuristics. This means that the delta rule will cause a network of connections to change in directions that maximize the change in an error term that sums the squares of output deltas. One way to view this feature is to see the delta rule as a skier who always moves with the fall-line in a breakneck journey back to the clubhouse.

Limitations of the Basic Delta Rule

The basic delta rule works quite well at assigning connections and connection weights in single-layered systems (involving only input units and output units), but it is unable to determine connection weights in a multilayered system involving *hidden units* (units that have no direct contacts with the outside world). In a careful analysis done nearly 20 years ago, Minsky and Papert (see reference 7) delineated a number of interesting computations that single-layered systems cannot perform. For example, they cannot compute the exclusive-OR. To take a concrete situation, a single-layer system cannot learn a preference for classes meeting on Monday or Wednesday evenings but not (e.g., because of time constraints) meeting both evenings. Table 1 illustrates the problem. There is simply no linear combination of variables M and W (for Monday and Wednesday classes, respectively) that will generate the desired values of the exclusive-OR.

In a sense, single-layered networks are limited to computations that map similar-looking input patterns into similar-looking output patterns. In many computations such as the exclusive-OR relation or the more general parity computation, a small change in the input pattern may necessitate a drastic change in the desired output pattern. In these instances, we need multiple-layered networks with hidden units. Through hidden units, the system can represent abstractions that it cannot directly encode from the environment via input nodes.

Figure 4 illustrates that a simple two-level network with only one hidden unit can compute the exclusive-OR. In this case, the hidden unit represents the abstraction "Monday and Wednesday." With the right set of connections to and from a large enough set of hidden units, a network can perform any desired mapping between input and output. (It is often the case that hidden units will also reduce the number of connections needed to perform a particular computation—a point we return to in the example of the next section.) Much of the current resurgence of interest in neural networks can be traced to the development of a powerful generalization of the delta rule that can arrive at such a set of connections in a multilayered system. This back-propagation rule (see reference 8) is described in the next section.

Back-Propagation

The equation that determines weight changes under the back-propagation rule is similar in form to that of equation 1. However, the back-propagation rule provides a more general means of computing the delta of a unit. On a given trial, the delta of an output unit is computed in

continued

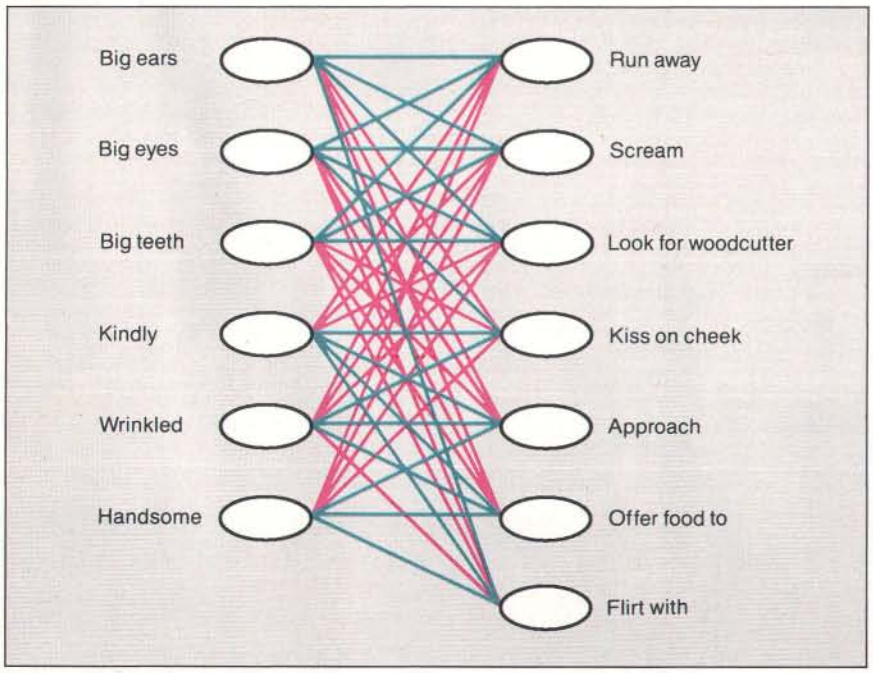


Figure 3: *A network produced by the basic delta learning rule.*

Table 1: *The exclusive-OR problem.*

Monday	Wednesday	XOR (M,W)
0	0	0
1	0	1
0	1	1
1	1	0

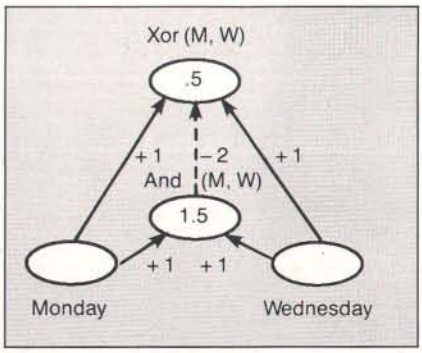


Figure 4: *A network solution to the exclusive-OR problem.*

Actual unretouched screen image.

Mitsubishi Has A Great Picture In-Store For You.

A High-Quality Line of PC Monitors Priced Below The Competition.

Introducing the Mitsubishi *brand name* family of PC Monitors. Select from five different IBM® compatible models, along with the new IBM PS/2™ compatible XC-1429C. Each has a 13V″ diagonal viewing area and proprietary high contrast glass for the sharpest image possible.

Affordably Priced PC Monitors

The XC Series incorporates proven Mitsubishi quality and reliability at an extremely affordable price. In fact, we've included a wide variety of features for which you'd expect to pay considerably more. Like advanced video and deflection circuits to reduce distortion and optional tilt and swivel base for improved ergonomics. Also in-line self-convergence for low power consumption and extra reliability.

The XC Series is available in quantity, ready to support a wide range of application needs—from standard word processing and business graphics to windowing and high resolution solids modeling and CAD.

Complete Customer Satisfaction

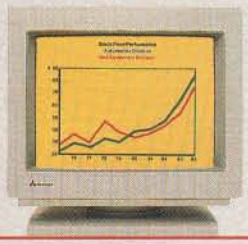
Mitsubishi stands behind its brand name XC Series monitors with knowledgeable applications and service personnel and backs each product with a comprehensive one-year warranty. It all adds up to a worldwide reputation for state-of-the-art electronics and unparalleled customer satisfaction.

Compare the picture quality and see for yourself why Mitsubishi monitor displays look so good.

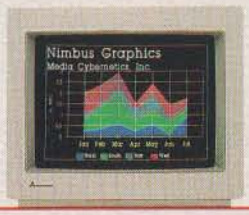
For product literature and your nearest distributor, call Mitsubishi today at 1-800-556-1234 Ext. 54. In California call 1-800-441-2345 Ext. 54. Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502.

Circle 185 on Reader Service Card
(Dealers: 186)

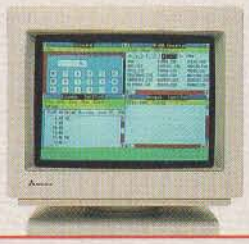
MITSUBISHI ELECTRONICS



XC-1409C
$519.00 Sug. Retail
IBM-CGA Compatible
Medium Resolution Monitor:
13V″ • 2,000 characters, 640 x 200 graphics resolution • TTL video input 15.75KHz • 16 colors 0.4mm pitch stripe mask



XC-1410C
$659.00 Sug. Retail
IBM-EGA Compatible
High Resolution Monitor:
13V″ • 2,000 characters, 640 x 350 graphics resolution • Dual-Mode/TTL video input 15.75/ 22.4KHz • 16/64 colors 0.4mm pitch stripe mask



XC-1430C
$739.00 Sug. Retail
IBM-EGA Compatible
High Resolution Monitor:
13V″ • 2,000 characters, 640 x 350 graphics resolution • Dual-Mode/TTL video input 15.75/ 22.4KHz • 16/64 colors 0.31mm fine dot pitch

XC-1412C
$799.00 Sug. Retail
IBM-PGC Compatible
High Resolution Monitor:
13V″ • 4,800 characters, 640 x 480 graphics resolution • Analog video input 30.49KHz • Infinite colors 0.31mm fine dot pitch

XC-1429C NEW!
$685.00 Sug. Retail
IBM-VGA Compatible
High Resolution Monitor:
13V″ • 4,800 characters, 640 x 480 graphics resolution • Analog video input 31.5KHz • Infinite colors 0.28mm fine dot pitch

much the same way as it is computed in the basic delta rule. Specifically,

$$\delta_{pj} = (T_{pj} - O_{pj})f'_j(net_{pj}) \qquad (2)$$

where $f'_j(net_{pj})$ is the derivative of a "squashing" function that operates on the sum of the inputs to a unit in order to determine the unit's output. A squashing function is a special kind of threshold function that is differentiable and nondecreasing. Such a function can be found in the listing of our C language implementation of the back-propagation rule. [Editor's note: *The source code for bpsim.c is available on disk, in print, and on BIX. See the insert card following page 304 for details. The listing is also available on BYTEnet. See page 4. Bpsim.c, which must be compiled and run on Unix systems, illustrates the Little Red Riding Hood example in this article.*] In a linear system with no squashing function, the output of a unit equals its input. In this special circumstance, the delta produced by the back-propagation rule is identical to that produced by the basic delta rule.

The real power of the back-propagation rule comes from its assignment of deltas to hidden units that receive no direct feedback from training patterns in the outside world. These deltas, in turn, influence the modification of weights to connections leading into the hidden units. The delta for a hidden unit is computed as follows:

$$\delta_{pj} = f'_j(net_{pj})\Sigma_k\delta_{pk}w_{kj} \qquad (3)$$

This is a recursive definition in which the unit's delta is determined by the derivative of its squashing function multiplied by the weighted sum of the deltas to which the unit sends activation via outgoing connections. A given delta term δ_{pk} in the summation is, in fact, weighted by the strength of the connection pointing from the hidden unit U_j to the unit U_k that is the source of the delta.

As the back-propagation rule's name suggests, the basic idea behind this computation of deltas for internal units is to propagate back through the system errors that are based on observed discrepancies between the values of output units and a training pattern. The deltas are first computed for the output units, and these are then propagated backward to all units pointing to the output units in the layer below. These units, in turn, propagate their received deltas backward to units that point to them, and so on, until the input level is reached. These deltas then drive the network's weight changes in much the same way as with the basic delta rule; the back-propagation rule, like its basic delta rule predecessor, is a gradient-descent heuristic.

We return to the tutoring of Little Red Riding Hood to illustrate the effects of the back-propagation rule with a more concrete example. Suppose we were to follow the same training procedure used to generate the network in figure 3, but now we introduce three hidden units. Initially, each input unit is connected (with some low, randomly determined weight) to all three hidden units; similarly, each hidden unit is connected to all output units. No connections are permitted that directly connect input to output units. We now have two layers of connections, necessitating the use of the back-propagation learning rule.

Figure 5 shows the results of this experiment. Interestingly, the hidden units have come to represent internally the concepts for wolves, grandmas, and woodcutters. It is often the case that hidden units, through the actions of back-propagation, will come to represent useful abstractions of the outside world. Note that the I/O mapping in this example does not require the use of hidden units. As figure 3 indicates, this mapping can be accomplished without hidden units using the basic delta rule. It is, nevertheless, interesting to note that the introduction of hidden units in figure 5 reduces the number of connections needed to represent the mapping.

Applications and Future Directions

In principle, the use of the back-propagation algorithm would seem to give a system the ability to induce an I/O mapping of arbitrary complexity—providing that the system has enough units and connections at its disposal. As such, the back-propagation algorithm and related work may profoundly alter our use of computers. Much of the current applied work on neural networks is focused on the construction of pattern-recognition systems (i.e., systems that can recognize handwriting, gestures, images, and so on). But the range of potential applications is clearly much broader.

Consider the economic value of a system that observes and eventually mimics the behavior of a domain expert. Currently, the construction of expert systems often requires an enormous amount of effort. Rules must be laboriously abstracted, entered, and checked for poten-

continued

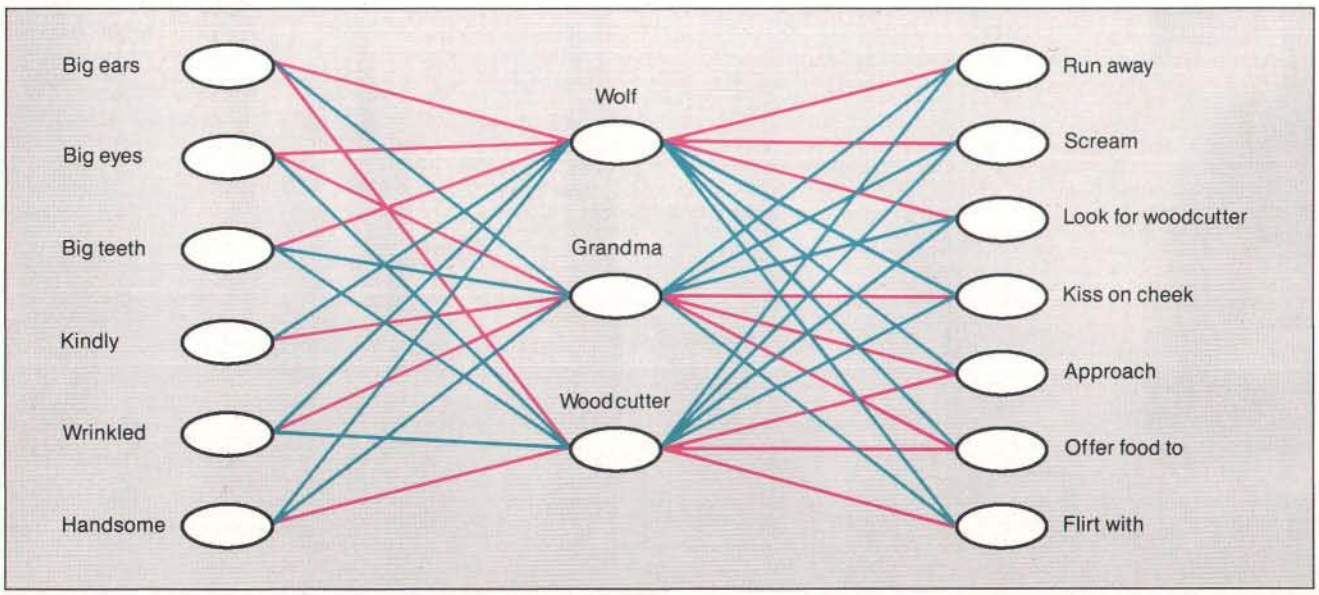


Figure 5: *A network produced by the back-propagation learning rule.*

GET THE KNOW-HOW TO SERVICE EVERY COMPUTER ON THIS PAGE.

Learn the Basics the NRI Way—and Earn Good Money Troubleshooting Any Brand of Computer

The biggest growth in jobs between now and 1995, according to Department of Labor estimates, will occur in the computer service and repair business, where demand for trained technicians will actually *double*.

You can cash in on this opportunity—either as a full-time corporate technician or an independent service-person—once you've learned all the basics of computers the NRI way. NRI's practical combination of "reason-why" theory and "hands-on" building skills starts you with the fundamentals of electronics, then guides you through advanced electronic circuitry and on into computer electronics. You also learn to program in BASIC and machine language, the essential languages for troubleshooting and repair.

Total Computer Systems Training, Only From NRI

No computer stands alone . . . it's part of a total system. To really service computers, you have to understand computer *systems*. And only NRI includes a powerful computer system as part of your training, centered around the new fully IBM compatible Sanyo 880 Series computer.

You start with the step-by-step assembly of the new, highly rated fully IBM compatible Sanyo 880 Series computer. You install and troubleshoot the "intelligent" keyboard. Then you assemble the power supply, install the disk drive, and add extra memory to give you a powerful 256K RAM system. The new 880 computer has two operating speeds: standard IBM speed of 4.77 MHz and a remarkable turbo speed of 8 MHz, making it almost twice as fast as the IBM PC. Next, you'll interface the high-resolution monitor and begin to use the valuable software also included with your complete computer system.

AND MORE!

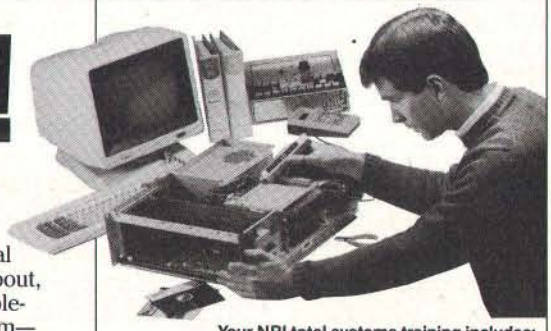
It all adds up to confidence-building, real-world experience that includes training in programming, circuit design, and peripheral maintenance. You'll be learning about, working with, servicing, and troubleshooting an entire computer system—monitor, keyboard, computer, disk drive, power supply—to ensure that you have all the essential skills you need to succeed as a professional computer service technician.

No Experience Needed, NRI Builds It In

This is the kind of practical, hands-on experience that makes you uniquely prepared, with the skills and confidence you need for success. You learn at your own convenience in your own home. No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. Your training is backed up by your personal NRI instructor and the NRI technical staff, ready to answer your questions and help you when you need it. You get it all with NRI at-home training.

100-Page Free Catalog Tells More

Send the postage-paid reply card today for NRI's big, 100-page, color catalog on NRI's electronics training, which gives you all the facts about NRI courses in Microcomputers, Robotics, Data Communications, TV/Audio/Video Servicing, and other growing high-tech career fields. If the reply card is missing, write to the address below.



Your NRI total systems training includes: • NRI Discovery Lab® to design and modify circuits • Your four-function digital multimeter with walk-you-through instructions on audio tape • Digital logic probe for visual examination of keyboard circuits • The newest Sanyo 880 Series Computer with "intelligent" keyboard and 360K double-density, double-sided disk drive • High resolution monochrome monitor • 8K ROM, 256K RAM • Bundled software including GW BASIC, MS-DOS, WordStar, CalcStar • Reference manuals, schematics, and bite-sized lessons.

NRI SCHOOLS

McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue, NW
Washington, DC 20016

We'll Give You Tomorrow.

tial incompatibilities with the existing rule base. Moreover, as the saying goes, "rules are made to be broken." All too often, expert systems are brittle, so that their performance precipitously degrades in situations not anticipated by their human designers. As an alternative, a neural-network approach using back-propagation may give us a system that essentially builds its own rule base with a minimum of outside intervention, so that over time it gradually takes over the tasks of the human expert. In this direction, work is currently under way to build an adaptive neural-network system to aid in fault detection and diagnosis in a chemical-engineering plant (see reference 13).

On the downside, neural-network implementations involving the back-propagation rule can be demanding of computational resources (see reference 14). As we noted, one general approach to this problem is to completely redo machine architecture in ways that support massively parallel computation. It may also turn out that many important applications permit limited implementations of the back-propagation rule that are extremely fast even on today's smaller computers.

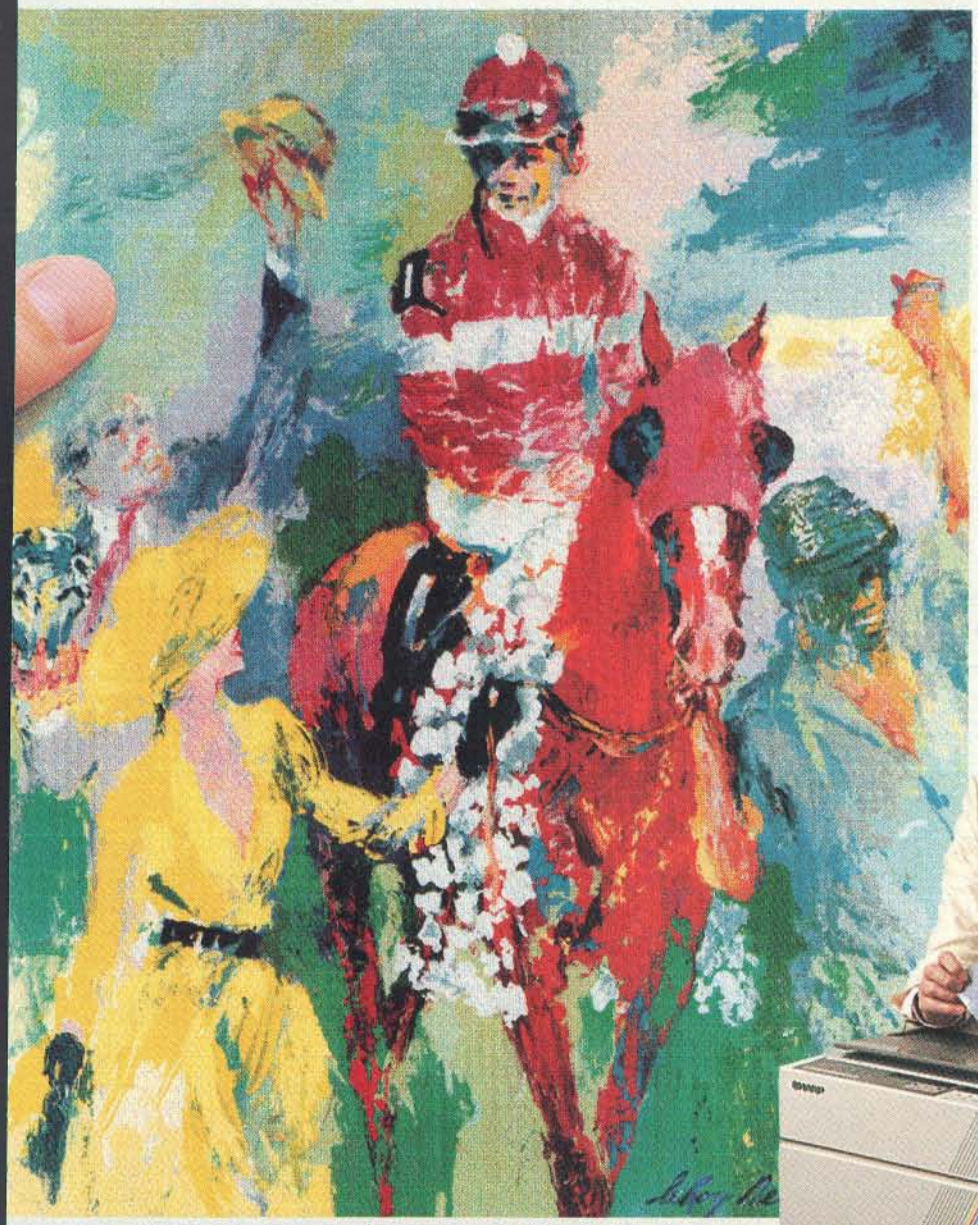
Will the neural-network approach, in conjunction with techniques such as the back-propagation rule, usher in a new age of computing? Or will it, like so many developments in the AI field, prove to have a grasp that falls far short of its reach? Only time will tell. ■

REFERENCES

1. Sejnowski, T. J., and C. R. Rosenberg. "NETalk: A Parallel Network That Learns to Read Aloud." JHU/EECS-86/01, School of Electrical Engineering and Computer Science, Johns Hopkins University, 1986.
2. Hinton, G. E. "Learning Distributed Representations of Concepts." In *Proceedings of the Cognitive Science Society*, Amherst, MA, August 1986.
3. Rumelhart, D. E. Personal communication, 1987.
4. Burr, D. J. "A Neural Network Digit Recognizer." In *Proceedings of IEEE International Conference on Systems, Man, and Cybernetics*, Atlanta, GA, October 1986.
5. Mozer, M. "RAMBOT: A Connectionist Expert System That Learns by Example." In *Proceedings of the IEEE First Annual International Conference on Neural Networks*, San Diego, June 1987.
6. Rosenblatt, F. *Principles of Neurodynamics*. New York: Spartan, 1962.
7. Minsky, M., and S. Papert. *Perceptrons*. Cambridge: MIT Press, 1969.
8. Rumelhart, D. E., G. E. Hinton, and R. J. Williams. "Learning Internal Representations by Error Propagation." In *Parallel Distributed Processing: Explorations in the Microstructures of Cognition*. Cambridge: MIT Press, 1986.
9. Parker, D. B. "Learning-logic." TR-47, Center for Computational Research in Economics and Management Science, MIT, 1985.
10. Le Cun, Y. "Une procedure d'apprentissage pour reseau a seuil assymetrique" ("A Learning Procedure for Asymmetric Threshold Networks). In *Proceedings of Cognitiva*, Paris, June 1985.
11. Rumelhart, D. E., and J. L. McClelland. *Parallel Distributed Processing: Explorations in the Microstructures of Cognition*. Cambridge: MIT Press, 1986.
12. Widrow, G., and M. E. Hoff. "Adaptive Switching Circuits." Institute of Radio Engineers, Western Electronic Show and Convention, Convention Record Part 4 (1960), pages 96–104.
13. Hoskins, J. C., and D. M. Himmelblau. "Neural Network Models of Knowledge Representation in Process Engineering." *Computers and Chemical Engineering* (in press).
14. Jones, W. P. "ANNA: An Adaptive Neural Network Associator for Personal Computer Interfacing," August 1987.

"WINNING COLOR...AND IT CAME OUT OF A SHARP COPIER".

This is an unretouched copy made by Sharp's new full-color copier.



FREE! A 20" x 30" poster of LeRoy Neiman's "Winning Color" when you visit an authorized Sharp dealer for a full-color copier demonstration.

LeRoy Neiman

Sharp's new full-color business copier, with its advanced technology, makes all others seem obsolete.

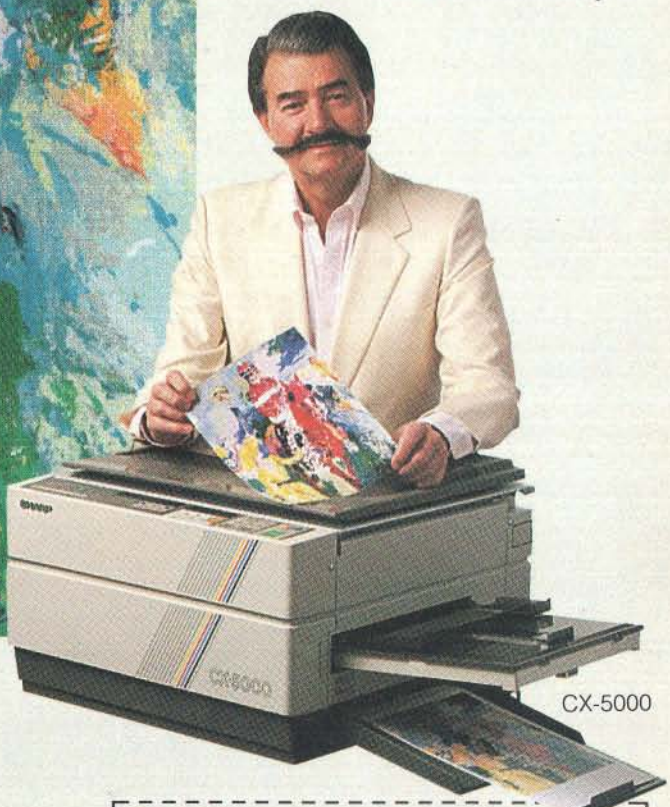
It captures all the vibrance of the LeRoy Neiman original. That's winning color—color that's alive.

And it can reproduce your business documents with the same astonishing results. From layouts to computer graphics.

It also enlarges, reduces, copies slides and makes transparencies. All in winning full-color at a surprisingly low price.

See an authorized Sharp dealer for a demonstration. You'll wonder how you ever got along without it.

For more information, call 1-800-BE-SHARP, or mail coupon.



CX-5000

Mr. James MacKenzie BY3
General Manager, Copier Division
Sharp Electronics Corp.
Sharp Plaza, Mahwah, N.J. 07430

Please send me more information on Sharp's full-color copier.

NAME _____

TITLE _____ PHONE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

SHARP
FROM SHARP MINDS COME SHARP PRODUCTS™

Circle 248 on Reader Service Card

Just What The Doctor Ordered. And The Lawyer. And The Architect...

The Quantus Turbo AT
- Monochrome monitor
- Half-height 40Mb hard drive
- 80286 running at 6-10MHz
- 1Mb RAM
- 8 expansion slots
- Text/graphics card
- Speaker
- 1.2Mb floppy drive
- 101-key enhanced keyboard
- 200 watt power supply
- 3 year limited warranty

$1495
COMPLETE

The Quantus MT386
- Monochrome monitor
- Full-height 80Mb hard drive
- 80386 running at 4.77/6/8/10/16MHz
- 2Mb RAM
- 8 expansion slots
- Text/graphics card
- Speaker
- 1.2Mb floppy drive
- 101-key enhanced keyboard
- 200 watt power supply
- 3 year limited warranty

$2995
COMPLETE

The Quantus Turbo XT
- Monochrome monitor
- Half-height 20Mb hard drive
- 8088 running at 4.77-8MHz
- 640K RAM
- 8 expansion slots
- Text/graphics card
- Speaker
- 360K floppy drive
- 84-key keyboard
- 150 watt power supply
- 2 year limited warranty

$795
COMPLETE

QUANTUS

Specifications and prices subject to change.

Circle 242 on Reader Service Card

Scientific Storage Technology
238 Central Street
Hudson, NH 03051

(800) 356-9001 (603) 886-3220
(800) 255-0125 (603) 363-4564

Optimizing Compilers

How compilers produce fast code, and how they could be improved

Mark Roberts

AN OPTIMIZING COMPILER'S purpose in life is not a simple one: It must attempt, by making the resulting machine code either smaller or faster, to improve a program's performance without changing the program's intent. Since small portions of a program account for most of the run time, streamlining the heavily used portions can result in a dramatic increase in performance. A good programmer, drawing on years of experience and expertise with the system hardware, can write efficient code for those critical routines that require fine-tuning. Compilers generate machine code without the benefit of representative input data or experience, so identifying and eliminating these performance bottlenecks turns into an automated guessing game.

A compiler using heuristic algorithms would eliminate the guesswork by using data gathered from the analysis of the program to generate the best code for a particular sequence of program instructions. I'll present some examples of C language code and the optimizations (or program transformations) that can be achieved by a compiler, briefly noting where heuristic capabilities could result in the generation of better code.

The Scope of Compilers

Optimizing compilers can be characterized by the *scope* of their optimizations; that is, how much of the user's program they will consider at one time while searching for and performing transformations. As you would expect, the complexity of a compiler increases dramatically as its scope expands.

The scope of program transformations can be broken down into five basic levels:

1. Statement: A single line of the program.
2. Basic block: A sequence of statements with only one entrance and one exit.
3. Loop: A sequence of statements executed repetitively.
4. Procedure (or Intraprocedural): An entire procedure (or subroutine or function). Although procedure-level optimization is often referred to as "global," this term is somewhat misleading, since a procedure is clearly not the most global view of a user's program. Since the bulk of literature uses the term *global* in this manner, I'll do the same for the sake of consistency.
5. Program (or Interprocedural): The entire program, not including assembly language and standard library routines.

Most compilers perform at least some optimizations at the block, or local, level (level 2). Since the data-dependence relationships within a basic block can be found by relatively simple analysis techniques, the optimizations performed on basic blocks can usually be more elaborate than those performed on the program as a whole. Many mainframe compilers optimize at the procedure, or global, level (level 4). Alternate methods of optimizations are also possible. For example, certain microcomputer compilers adopt optimization strategies similar to those of mainframe compilers, but, instead of operating on procedures, these compilers limit their global optimizations to loops. A compiler using interprocedural optimizations and heuristic techniques could perform optimizations using data gathered from the analysis of most of or all the procedures in a program.

Optimization Techniques

Optimization techniques fall into two basic classes: *machine-independent* and *machine-dependent*. This article focuses on a number of machine-independent optimizations, but I'll also cover some machine-dependent techniques as well.

Machine-independent techniques focus on an intermediate representation of a program—the program's logic—that is independent of the target machine. Machine-independent optimizations preserve the semantic correctness of the program but reduce its running time, memory requirements, or both. This is not to say that these techniques are totally divorced from the architecture of the processor involved: Not all machine-independent program transformations will run with equal facility on certain machine architectures.

Machine-dependent optimizations must also preserve semantic correctness but focus on using the strengths and weaknesses of a particular machine architecture.

Both techniques reorganize the structure and elements of a programmer's code

continued

Mark Roberts is manager of the Compiler Technology Group at Microsoft Corp. (16011 Northeast 36th Way, P.O. Box 97017, Redmond, WA 98073).

The trade-off is more activity and slower speeds at compile time for faster programs at execution time.

when it is compiled. These manipulations basically reduce the amount of code the computer must handle at execution time, so the program runs with increased efficiency. The trade-off is increased activity and slower speeds at compilation time in exchange for faster programs at execution time. It's important to note that while these optimizations by no means guarantee the best possible code, the results should at least mean a reduction in code size or an increase in speed. Moreover, an optimizing compiler obtains results far quicker than a programmer.

Some Machine-Independent Techniques

As stated earlier, certain optimizations can be performed by analyzing the program's logic. These logic optimizations are independent of the machine type and are usually independent of the programming language being used. Let's look at several things that can be done to reduce code in a program.

Constant arithmetic: Also known as constant folding, this technique evaluates constant expressions at compile time and replaces them with the computed result. Arithmetic expressions should be evaluated the same way at compile time as they are at run time, since many constant expressions arise through the use of symbolic constants in these expressions. Constant terms in array subscript expressions can be integrated with the array address at compilation time. Unnecessary arithmetic, such as `m * 1` or `b - 0`, and unnecessary logical operations are eliminated. Conversion of a constant from one type to another is performed.

As a simple example of constant folding, the statement `flt = 1.5 + 3.2;` is compiled as `flt = 4.7;`.

Constant propagation: This replaces the use of variables assigned a constant by the constant itself. This in turn can create more opportunities for constant folding. For example, `j = 2; k = j + 5;` are compiled as `j = 2; k = 7;`.

Common subexpression elimination: This technique involves finding and eliminating those computations that calculate values already available. An occurrence of an expression E is called a *common subexpression* if E was previously computed and the values of the variables in E have not changed since the previous computation.

Common subexpressions can be saved in registers or memory and accessed there instead of being recalculated at each use. With the use of this technique, expressions such as

```
a = b + c * d; ... x = c * d/y;
```

are compiled as

```
t = c * d; a = b + t; ... x = t/y;,
```

where `t` is a compiler-generated temporary variable that will be assigned to a register where possible.

Dead store elimination: A variable is "live" at a point in a program if its value is subsequently used; otherwise, it is "dead" and can be eliminated. A related idea is dead or useless code—code that computes a value that is never used. While a programmer is unlikely to intentionally introduce dead code, it can appear as the result of previous transformations, such as constant folding or copy propagation.

Copy propagation: References to a variable can be replaced by the expression previously assigned to that variable. For example, consider the statements

```
x = a + b;      c = a;      y = c + b;.
```

Copy propagation would determine that the variable `c` can be discarded and replaced with `a`, so that `y = c + b` becomes `y = a + b`. Copy propagation alone is not an optimization, but combined with common subexpression elimination, dead store elimination, and the appropriate register allocation (which I'll discuss in more detail later), the program may be improved. Continuing with our example, the statements ultimately compile as

```
t = a + b;      x = t;      y = t;,
```

where `t`, as before, is a temporary variable.

Two recent types of machine-independent optimizations are *interprocedural constant propagation* and *procedure embedding*. Interprocedural constant propagation would analyze all procedures in a program (level 5) rather than from within a procedure (level 4) to perform optimization by constant propagation. In procedure embedding, a procedure call is treated as a macro expansion; that is, the text of the procedure is expanded in-line and optimized together with the calling routine. The optimizer could then fold constant arguments into the code or move invariant instructions into less frequently executed regions of the calling routine. In both cases, heuristic analysis could provide the capabilities of selecting the optimizations across procedures that would generate smaller and faster code. Since each program is unique, heuristics would provide the flexibility to handle special or unusual cases when the rules presented here break down.

Loop Optimizations

An important place for other machine-independent optimizations is loops (level 3), especially inner loops, where programs tend to spend the bulk of their time. We can improve program execution time by decreasing the number of instructions in an inner loop, even if that increases the amount of code outside the loop. Three techniques are important for loop optimization: invariant code motion, strength reduction, and induction-variable elimination.

Invariant code motion: The intent of code motion is to move instructions from frequently executed areas of the program to less frequently executed areas. An expression can be moved out of a loop if the value it produces is not changed by this move and if it computes the same value for every iteration of the loop. For example, the statement

```
for (i = 0; i < 10; i++)
   array[i] = x + y;
```

would be compiled as

```
t = x + y;
  for (i = 0; i < 10; i++)
    array[i] = t;.
```

Since relative execution frequencies of various areas of a program are not always readily apparent, moving code may not always improve the results.

Strength reduction: This optimization replaces certain computations that use recursively defined variables with recursively defined computations that use less computationally expensive machine operations. By way of example, the statement

```
for (i = 0; i < 10; i++)
   array[i] = i * 4;
```

would be compiled as

```
t = 0;
for (i = 0; i < 10; i++)
   {
   array[i] = t;
   t += 4;
   }.
```

continued

SOMETIMES, THE ACID TEST OF OUR MICROPROCESSOR DEVELOPMENT TOOLS IS UP IN THE AIR.

Two miles up, in the belly of a U2 jet, the U.S. Government is now tracking acid rain and radioactive particles with a just-developed device called an Upper Air Sampler.

But months earlier, with expensive development hardware on the blink, timely completion of the project was in real jeopardy.

Luckily, Avocet was called to the rescue. And within 48 hours we came through. With "the best software development tools" their design engineer had ever seen.

Not to mention, down-to-earth prices.

Let Avocet turn your PC or VAX into a powerful, integrated development system in 48 hours, even overnight.

Avocet can help you turn more good ideas into more real products in less time.

Just call us now and we'll get you up and running—with everything you need to turn your computer into a personal, professional development system.

All at a modest price. From a single source. Backed by the reassurance of a technical hotline. So friendly, knowledgeable support is always as close as your phone.

No wonder design engineers with no time to spare come to us first—and keep coming back smiling.

Any similarity to Intel, Hitachi or Motorola is purely intentional.

Avocet's professional quality AVMAC™ assemblers run on any PC-compatible with DOS or Xenix. And on VAX Unix. Just released, *AVMAC Version 2.0* has major speed improvements to assure you lightning-fast assembly. Plus, enhanced compatibility with Intel, Hitachi, Motorola & other chip makers—so you can convert existing code more easily than ever before.

Each AVMAC package comes complete with our AVLINK™ linker, AVLIB™ librarian, AVREF™ cross-reference generator and new 200+ page AVMAC *User's Guide*—all the assembly tools you want and need.

After assembly, check your program with AVSIM™—widely acclaimed as the best simulator/debugger in the industry. AVSIM tests target μP code right on your PC—with no special hardware. It's crashproof. And what you see is what you get: AVSIM's full-screen display gives you instant visual access to the entire CPU—registers, memory, I/O ports, even attached peripheral chips.

Target Microprocessor Families Supported

1802/1805	68000/68010	COP400
6502/65C02	68020	HD64180
6801/6301	8048/8041	NEC 7500
6804	8051/8052	TMS-32010
6805/6305	8085	TMS-32020
6809	8096	Z8
68HC11	F8/3870	Z80

Host Operating Systems

CP/M DOS PC Xenix VAX Unix

AVMAC Macro Assemblers ..... from $349
AVSIM Simulator/Debuggers ..... from $379
Other Development Tools ..... Call

CALL TOLL-FREE 800-448-8500*

to order or receive our latest catalog of microprocessor development tools

Try before you buy.

Order your AVMAC assembler and AVSIM simulator/debugger today and we'll include a special demo kit for both. Try the demo for 30 days. If you're not satisfied for any reason, return the unopened products for a full refund, less the $35 demo/documentation kit which is yours to keep.

Avocet Systems. We help you get your job done, on time and on budget.

Avocet Systems, Inc., 120 Union Street
P.O. Box 490AI, Rockport, Maine 04856
*Outside US and in ME, call (207) 236-9055
TLX: 467210 AVOCET CI FAX: (207) 236-6713

Avocet delivers all the tools you need—in 48 hours or less. Ask about our AVPROM™ and AVPAL™ programmers. And our NEW 8051 in-circuit emulator, development boards, AVPAS 51™ cross-compiler—and AVKIT,™ the total Unix toolbox for DOS, including the incomparable VI editor.

AVOCET
SYSTEMS, INC.®
THE SOURCE FOR PERSONAL μP DEVELOPMENT TOOLS.

Circle 312 on Reader Service Card for inquiries in the U.S. and Canada. (Outside North America: 313)

The advantage here is that a particular computation (the multiply statement) is replaced by a faster one (the addition with sum statement).

A more important example of strength reduction would be optimizing the use of the `array[i]` term. The address calculation probably involves a multiply by 2 or 4. Hence, the code produced by an optimizing compiler for this example would resemble typical C language array referencing with pointers:

```
t = 0;
p = &array;
for (i = 0; i < 10; i++)
   {
   *(p++) = t;
   t += 4;
   }.
```

Notice that `i` is no longer used in the loop at all. This leads us to our next subject.

Induction-variable elimination: In the context of this article, an induction variable is a variable whose value is modified by a fixed amount each time the loop is executed. When there are two or more induction variables in a loop, it may be possible to eliminate all but one.

After performing the strength-reduction optimization and introducing new recursively defined variables, frequently the only use for the original recursively defined variable is for the loop-control test. This test can often be replaced by a test on one of the introduced variables, thereby making the instructions associated with initializing and incrementing the program variable no longer necessary. Our example now becomes

```
p = &array;
for (t = 0; t < 40; t += 4)
   *(p++) = t;,
```

where the induction variable `i` has been replaced by the variable `t`.

Loop unrolling: A loop can be unrolled completely so that the successive computations implied by the loop appear sequentially, or it can be partially unrolled, as in the following example. The original loop code looks like this:

```
for (i = 0; i < 100; i++)
   a[i] = a[i] + b[i];.
```

When the loop is unrolled by 2, the code becomes

```
for (i = 0; i < 100; i += 2)
   {
   a[i] = a[i] + b[i];
   a[i+1] = a[i+1] + b[i+1];
   }.
```

Loop unrolling has two major advantages. First, the number of increments and tests for loop control is cut in half in this example. Second, more instructions are exposed for parallel execution. Nests of loops can also be unrolled. A loop with variable control parameters, such as `for (i = j; i < k; i += 1)`, can be unrolled, but it requires extra code to test for end conditions.

The major disadvantage of loop unrolling is that it improves performance at the cost of additional instructions. For this reason, the criteria for unrolling loops should include the size of the loop and the relative frequency of executing the loop. Other factors include the severity of the object space constraints and the form of the loop itself. In these situations, an experienced programmer can decide whether to unroll a loop. Heuristic analysis of these criteria in a compiler could allow sensible code-generation of program loops, and in a fraction of the time.

Loop jamming: In this transformation (also called loop fusion), two loops are put together and expressed by one loop. This reduces loop overhead and code space while exposing more instructions for parallel execution and local optimization. Since there are no disadvantages to making this transformation, it should be used wherever possible.

The cases that can be transformed are relatively simple or fairly elaborate. The simplest case involves two loops that together satisfy several criteria. First, if one loop is executed, then so is the other one; that is, the two loops should have the same execution conditions. Second, the computations in one loop do not depend on computations in the other. This criterion can easily be relaxed in particular situations. Last, the loops are executed the same number of times. By generating code for the end conditions, this criterion can be relaxed as well.

Here's an example of a simple case. The code for the two loops is

```
for (i = 0; i < 100; i++)
   a[i] = 0;
for (i = 0; i < 100; i++)
   b[i] = x[i] + y;,
```

which becomes

```
for (i = 0; i < 100; i++)
   {
   a[i] = 0;
   b[i] = x[i] + y;
   }.
```

The need for this transformation may arise when compiling languages that have array or vector operations. If statements involving these operations are translated to the more basic element-by-element operations, fusible loops and nests of loops may appear frequently in the code.

Machine-Dependent Techniques

Rather than manipulating a programmer's code, machine-dependent techniques involve determining the fastest way to perform a specific operation, given the architecture of a processor. The intent of machine-dependent optimizations is, figuratively, to squeeze the processor for every possible degree of speed by using all its features to optimum advantage. I'll look briefly at register allocation, operand permutation, instruction scheduling, and peephole optimization.

Register allocation: One key to designing an optimizing compiler is to make efficient use of the target machine's registers. It takes a comparatively long period of time for the processor to retrieve data from memory, as opposed to retrieving it from registers. Therefore, the goal is to maintain "register residency" for values used most often in a user's program.

Allocating registers is possibly the most difficult optimization to perform. Several issues can be isolated in the use of this optimization technique. The first issue is whether register allocation can be separated from register assignment. Allocation involves determining how many program values should be held in registers. Assignment involves determining which actual hardware registers will be used for each allocated register. One problem associated with register assignment is boundary matching: An entity used in two or more program blocks that are executed sequentially should be assigned to the same register, if possible.

The second issue is load-store motion. Load-store motion moves the `LOAD` and `STORE` instructions out of loops to retain intermediate results in registers and to avoid unnecessary storage references. However, other instructions can also be moved to obtain a better allocation.

The last issue is using local or global allocation and assignment of registers. The allocation of code within a basic block (local) may use simpler techniques than allocation across basic-block boundaries (global), since the latter must consider control flow. An optimizing allocation normally consists of both local and global allocation.

Operand permutation: By changing the order of evaluation of expressions, the number of registers needed to do a calculation can be reduced. For example, since results require fewer registers than computations, you might always generate the operation that needs the most registers first. Once the complex operation is per-

continued

AutoSketch™

A Resource to Draw Upon

To get any job done, you need the right tools. Ideally, they should be extensions of your talents, freeing you to do what you do best. And speed, precision, flexibility, and consistency are always top priorities, no matter what the job.

If communicating with drawings is part of your job, AutoSketch should be one of your resources.

AutoSketch from Autodesk, the developers of AutoCAD,® is the precision drawing tool for professional use. It's fast, powerful, and simple to learn. The price is right, too.

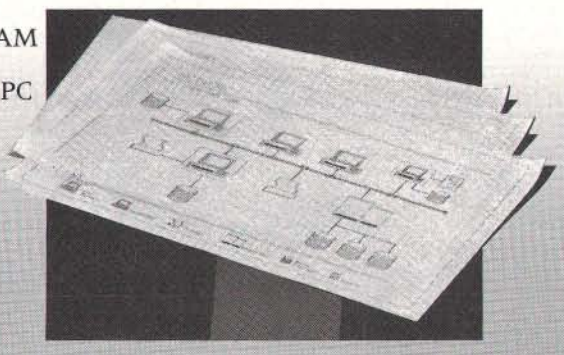
With AutoSketch and your personal computer, you'll enter the world of computer-aided drawing with ease. You may never have designed with a PC before, and you may think it's bound to be complicated and time-consuming. Surprise! With AutoSketch, you'll probably be up and running in about an hour.

Despite its ease of use, AutoSketch is a full-function, object-oriented CAD program. Pull-down menus and dialog boxes help you each step of the way. With a click of the mouse, you can draw, then copy, mirror, or move objects, even create symbol libraries. AutoSketch automatically updates measurements whenever you stretch, scale, or rotate dimensioned objects. It even keeps track of everything you do, so that you can delete and restore parts of your drawing as easily as you change your mind, using successive undo or redo commands.

We know you'll be impressed with the professional results. So will your clients and colleagues.

AutoSketch runs on the IBM PC/XT/AT and compatible systems with a minimum of 512K RAM and either color or monochrome display. The standard version is yours for just $79.95. If your PC has an 8087 or 80287 math coprocessor, this version operates about three times faster. The speed-enhanced version for $99.95, requiring the coprocessor, is three times faster still.

Call 800-445-5415 for the name of the AutoSketch Dealer nearest you or more information on supported peripherals. To order direct with a credit card, call **800-772-9200, ext. 347.**



Circle 24 on Reader Service Card

formed, you have registers free that can store the results of the operation for further optimizations.

Instruction scheduling: In this optimization, sequences of instructions are ordered to minimize the execution time of the sequence. This optimization is of particular importance when the target processor has a pipelined instruction fetch. For example, instruction scheduling is important on many reduced instruction set computers (RISCs) that always prefetch and execute the instruction following a branch instruction, regardless of whether the branch is taken. Rather than simply place a `NOP` after the branch, an optimizing compiler can often reorder the instruction sequence to place a useful operation there.

Peephole optimization: The final code from a compiler can often be improved simply by a local scan of the sequence of instructions. A window of 5 to 10 instructions can be examined for possible transformations. When certain combinations of instructions are detected, they can be replaced by a smaller and/or faster set of instructions that accomplish the same function.

In addition to the machine-dependent optimizations just presented, most processor/operating-system combinations have a "standard" calling sequence used to invoke most external procedures. An interprocedural optimizer, coupled with heuristic analysis of the code, could modify this protocol on a procedure-by-procedure basis. For example, a function `random()` that has only a single floating-point argument could be compiled to always get its argument in a specific floating-point machine register. This might save both a `PUSH` and a `POP` via the normal argument stack.

A Look into the Future of Compilers

Compiler research is being conducted in a wide variety of areas today. A cursory look at recent computing literature will attest to this. Two interesting directions that relate directly to the topics covered in this article are interprocedural optimization and vectorization/parallelization. Richardson and Ganapathi have produced a good bibliography covering interprocedural optimizing, and Padua and Wolfe present a survey of vectorization in the December 1986 *CACM*.

I've mentioned instances in this article where interprocedural optimizations could assist in the generation of better code. Another possibility would be optimizations based on execution profile data maintained by the development environment—the heuristic analysis I've mentioned. One example would be a technique that biases the code generated for `if` statements so that the most frequently occurring case is the fall-through path. This can improve execution performance on machines like the Intel 80386 by keeping the instruction prefetch queue full.

Vectorizing compilers have been around since the late 1970s, but until recently, only a few programmers with access to a Cray or Cyber supercomputer have used one. But as the cost of high-performance computers continues to fall, we will see more and more medium-priced vector machines, as well as "supercomputers" based on networks of so-called general-purpose microprocessors. Compilers that can discover and exploit the parallelism inherent in many programs will be needed to take full advantage of these machines.

Owning today's microcomputers is comparable to having a 1960s mainframe on your desk. As these machines become more powerful, users expect more from a compiler to help them take advantage of this power. User demand, together with the machine's advancing capabilities, is leading us toward better and more powerful compilers. Within as little as a year or two, we will probably see truly state-of-the-art optimizing compilers for the microcomputers now on our desks. ■

BIBLIOGRAPHY

Aho, A. V., R. Sethi, and J. D. Ullman. *Compilers—Principles, Techniques, and Tools*. Reading, MA: Addison-Wesley, 1986.

Allen, F. E. "Bibliography on Program Optimization." Research Report RC-5767, IBM T. J. Watson Research Center, 1975.

Chow, F. *A Portable Machine-Independent Global Optimizer*. Ph.D. thesis, Stanford University, 1983.

Cooper, K. D., K. Kennedy, and L. Torczon. "The Impact of Interprocedural Analysis and Optimization on the Design of a Software Development Environment." *Sigplan Notices*, vol. 20, no. 7, 1985, pages 107–116.

Lowry, E. S., and C. W. Medlock. "Object Code Optimization." *Communications of the ACM*, vol. 12, no. 1, 1969, pages 13–22.

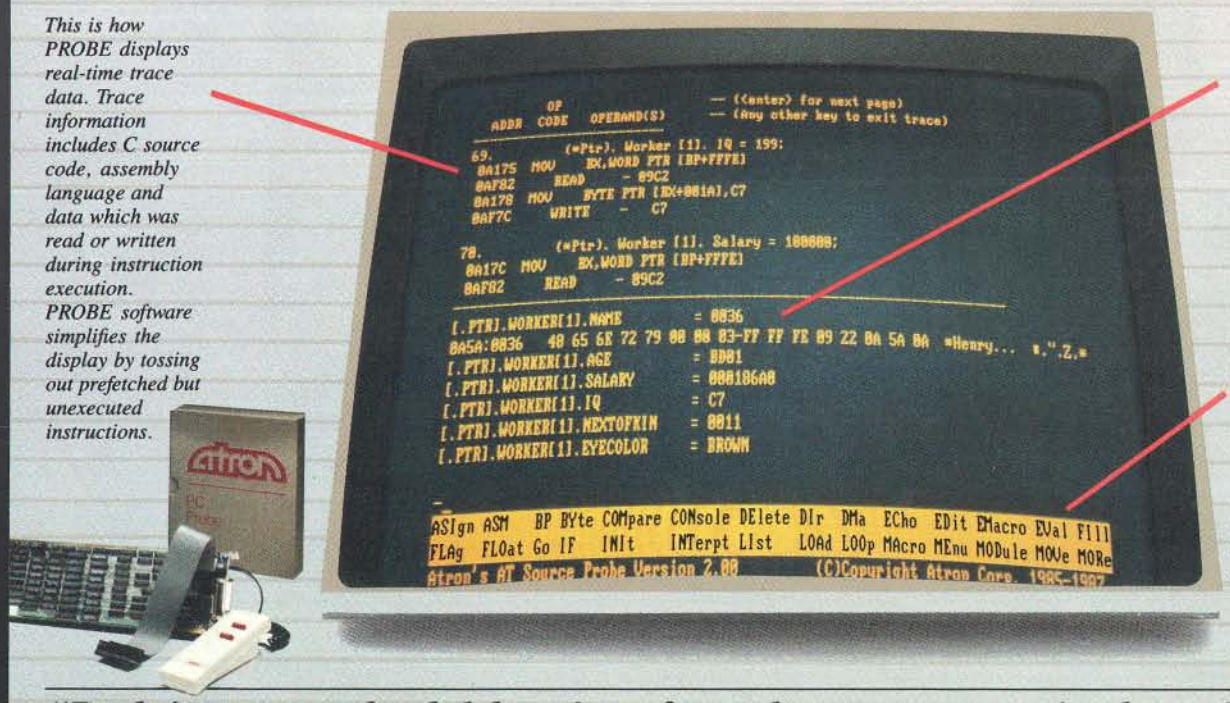
Padua, D. A. and M. J. Wolfe. "Advanced Compiler Optimizations for Supercomputers." *Communications of the ACM*, vol. 29, no. 12, 1986, pages 1184–1201.

Richardson, S., and M. Ganapathi. "Interprocedural Analysis—A Bibliography." *Sigplan Notices*, vol. 22, no. 6, 1987, pages 12–17.

Scarborough, R., and H. Kolsky. "Improved Optimization of FORTRAN Object Programs." *IBM Journal of Research and Development*, vol. 24, no. 6, 1980, pages 660–676.

WHO YA GONNA CALL? BUGBUSTERS!

This is how PROBE displays real-time trace data. Trace information includes C source code, assembly language and data which was read or written during instruction execution. PROBE software simplifies the display by tossing out prefetched but unexecuted instructions.



PROBE knows all about your local and complex variables. You can display and change an array of structures as easily as shown in this display.

PROBE's menu window means you do not have to look up debug commands in the manual. Entering the command name shows you command syntax.

"Real-time source-level debugging of very large programs simply can't be done without Atron's AT PROBE." *Ed Oates, Director of PC Software Development, Oracle Corporation*

The good news with your new Microsoft 4.0 or Lattice* C compilers is that they're providing more symbolic debugging information than ever. The bad news is you can't fit your program, a software debugger and that monster symbol table into memory - at least at the same time.

The great news is that Atron's AT PROBE™ hardware-assisted software debugger not only has 1-MByte of onboard memory for debugger and symbol table, but it now supports local variables and complex data types.

The AT PROBE is a debugging tool that plugs into your PC AT and monitors everything the processor is doing. In real time.

REAL TIME DEBUGGING. SOONER OR LATER, YOU KNOW YOU'LL NEED IT.

The AT PROBE's hardware-assisted breakpoints trap on reading, writing, executing, inputting and outputting. On single or ranges of addresses, including particular variable values. All in real time. For a mere software debugger to attempt this, a 1 minute program would take 5 hours to execute.

OPTIMIZED CODE - GOOD, BAD AND UGLY

The good news is optimizing compilers generate very tight code. The bad news. The time to debug optimized code is inversely proportional to the quality of the optimizer. Figuring out how in the world you ended up somewhere gets ugly, fast.

With AT PROBE's real-time trace capability, program execution history is saved on-board, in real time. Once a hardware trap has occurred, PROBE displays the program execution in detail, including symbols and source code. Real-time trace can show you how out-of-range pointers got that way. And there's really no other way to debug interrupt-driven code.

AT PROBE OPTIMIZES THE OPTIMIZED

When the job of bugbusting is done, your AT PROBE becomes a performance analyzer. So you can have both reliability *and* performance. So you can send only the best software into the field.

CALL TODAY FOR YOUR FREE BUGBUSTING MANUAL

Nine of the top ten software packages were debugged using Atron tools. Our complete tutorial on state-of-the-art bugbusting is yours, free. Full of examples and illustrations, it will show you how to become a bugbuster yourself.

Call today. Bust bugs tomorrow.

BUGBUSTERS
A division of Northwest Instrument Systems, Inc.
20665 Fourth Street • Saratoga, CA 95070
408/741-5900

Circle 22 on Reader Service Card

*Soon to be supported. Adv. by TRBA.

Can You Talk To Your Modem...

SPRING

Springmodem 1200X lets you talk during data file transmission.

Auto Data/Voice Transfer

Springmodem lets you transmit a data file, then switch to voice mode to discuss and analyze the information. With the revolutionary new Springmodem you go directly from data mode to voice mode simply by picking up your telephone receiver. You are now ready to speak to another Springmodem user. To return to data mode simply hang up the receiver. Springmodem will do the rest . . . with no data loss concerns.

Auto Swap Dial

With your new Springmodem you can now swap dial automatically. If the number you are calling is busy Springmodem will keep dialing, either the same number or another number, whichever you prefer, until the line is free and can be connected.

*Hayes is a registered trademark of Hayes Microcomputer Products, Inc.

..And Does It Understand?

- Fully Hayes* Compatible
  - Runs Crosstalk, PC talk
  - Frame Work, Symphony
  - PROCOMM
- AT Command Compatible
- Asynchronous Data Transmission
- 1200-300 BPS Data Transmission
- Auto Dial/Auto Answer
- Full or Half Duplex
- To guarantee voice data transfer two Springmodems are needed
- One year warranty.
- Suggested retail price $189.00

Call Spring Circle Technology for more information about this outstanding modem. Dealer inquiries are welcome.

SPRING PERSONAL COMPUTERS

SCTi SPRING CIRCLE TECHNOLOGY, INC.

717 Industry Drive, Seattle, WA 98188
Tel.: (206) 575-8086 • Fax.: (206) 575-6808

Circle 260 on Reader Service Card

A Search Strategy for Commonsense Logic Programming

A heuristic algorithm for searching

Paul V. Haley

PROLOG, THE DE FACTO logic programming language, is widely assumed to be a problem solver that reasons logically. However, its fixed search strategy often causes its reasoning to violate our notions of common sense.

Just as human beings use common sense to cope with the real world, real-world computer programs need to be able to pursue appropriate goals. I'll discuss some architectural characteristics that would enable a truly logical programming language to implement common sense using heuristics. Incorporation of heuristics in modern programming languages could give us the ability to write "smart" programs. Smart programs should be more efficient than programs that use brute-force algorithms.

Unfortunately, an actual solution to the problems associated with certain kinds of inefficient programs does not yet exist. My goal here is to stimulate thought about logical reasoning using searches, and how such searches might be made to more closely resemble human approaches to problem solving. Unfortunately, even though I outline the scheme for a solution to the problems associated with "dumb" programs, an actual solution does not yet exist.

Initial States

Any problem solver starts in an initial state and determines a sequence in which to apply appropriate operators in order to transform the initial state into a goal state. Prolog's states are the goals on its stack and the contents of its propositional database (predicates and facts). Prolog's operators are its rules of logical implication. These rules generate goals and deduce new facts that change Prolog's problem-solving state.

Conventional programming languages provide a rich vocabulary of control constructs that, when used properly, can lead a program directly to a solution. Searching is performed at the option of a programmer and is expressed using these unambiguous control constructs. Prolog, on the other hand, provides very little in the way of direct control. Prolog's rules of logical implication are best viewed as statements of truth, with the language itself deciding when to apply a rule.

Prolog determines whether something is true by first looking for an explicit proposition in its database. It then tries to derive this proposition by checking whether it is implied by other contents of the database. To determine whether something is implied, given these contents, Prolog must search for an applicable rule. Since more than one rule might be capable of determining whether something is true, Prolog must choose a rule to investigate first.

All Prolog implementations check rules in the order in which they occur; this is referred to as *depth-first* search. Since, in checking a rule, Prolog might need to find out if some other thing is true, it also supports recursion by using a stack. When going back up the stack from a failure to determine something to be true, Prolog is said to *backtrack*. Thus, Prolog's control algorithm is depth-first searching with backtracking.

In general, the search strategy used by an inference engine has a direct impact on the efficiency and the intuitive plausibility of the resulting logical reasoning. The search strategies used manifest themselves in reasoning behaviors that can have varying degrees of efficiency and that vary in their plausibility as cognitive models of how people reason. As always, efficiency is important in computer programs. However, for programs attempting to emulate human problem-solving capabilities, the plausibility of the reasoning employed takes on critical significance. Programs that behave mechanically until they stumble across a solution to a problem are clearly less intelligent than programs that proceed directly toward a solution without wasting time pursuing fruitless directions.

The Problem

For example, to get from point A to point B, you might be able to walk, ride, or fly. You might walk to your car, ride to the airport, and fly to your destination. If no direct flight was available, you might travel to an intermediate destination and travel on from there. The following Prolog pseudocode encodes some of this knowledge.

```
Travel(A,B) := Walk(A,B);
               Ride(A,B);
               Fly(A,B).
```

continued

Paul V. Haley is vice president for research and development at Intelligent Technology Inc. He can be reached at 115 Evergreen Heights Dr., Pittsburgh, PA 15229.

In Prolog, there can never be a goal more relevant than the one most recently generated.

```
Ride(A,B) :- Drive(A,B);
             Bike(A,B);
             Taxi(A,B);
             Train(A,B);
             Bus(A,B).
```

Few people trying to get from New York to London would seriously consider walking or taking a bus or taxi. Common sense would dictate that you needed to fly. Once you knew how to take care of the unfamiliar parts of the trip, you would think for a moment to ensure that you could get a ride to the airport. You would probably never think of walking at all. However, consider the behavior of the Prolog program below. Without going into great detail, the program would pursue, fail to achieve, and finally achieve goals something like this (<= denotes a failure to achieve, and => indicates achievement of a goal):

```
=> Goal(Travel(New York,London))
   => Goal(Walk(New York,London))
   <= Goal(Walk(New York,London))
   => Goal(Ride(New York,London))
   => Goal(Drive(New York,London))
   <= Goal(Drive(New York,London))
   => Goal(Bike(New York,London))
   <= Goal(Bike(New York,London))
   => Goal(Taxi(New York,London))
   <= Goal(Taxi(New York,London))
   => Goal(Train(New York,London))
   <= Goal(Train(New York,London))
   => Goal(Bus(New York,London))
   <= Goal(Bus(New York,London))
   <= Goal(Ride(New York,London))
   => Goal(Fly(New York,London))
   => Fly(New York,London)
=>Travel(New York,London)
```

This Prolog program does not display common sense. Because it pursues a goal by checking the next rule that might achieve that goal, Prolog is prone to a fatal catch-22: It can't pursue the most relevant goal if that goal hasn't already been generated. However, Prolog generates goals only by checking the next rule that could derive the most recent goal. That is, Prolog never generates an alternative goal. Thus, there can never be a goal that is more relevant than the one most recently generated. This is not very satisfying.

It is difficult to write a Prolog program that will display common sense in a variety of situations. For instance, in our travel example, many considerations must be weighed to qualify the feasibility of driving as an appropriate mode of transportation: There has to be a road to drive on; the road has to be passable; there must be a car; it must start; it must have enough gas to travel at least as far as the next gas station; the next gas station has to be open; if the car has a diesel engine, the gas station has to sell diesel fuel; there must be sufficient money to pay for the fuel required; and so on. All these conditions would have to be explicitly stipulated and satisfied.

People don't consider every possible detail in this way. They solve such trivial problems without effort; it's simply "common sense." They think about roads only if they know they will be driving; they don't worry about gas stations unless there is a compelling reason, such as crossing an uninhabited desert.

Common sense seems to involve choosing what to consider and what to ignore. Unfortunately, deciding to ignore certain details can result in unsound or incomplete "logical" formulations. For example, by not considering whether there is a road to the top of Mount Everest, a program might reach the unsound conclusion that one could drive there. Fortunately, deciding the order in which to consider things will never, in itself, lead to an erroneous conclusion. If the first goal considered is unfruitful, the correct alternative is not abandoned—it is only delayed. To the extent that a program orders alternatives intelligently, it will pursue fewer fruitless goals and therefore be more efficient.

Consider again our travel rule:

```
Travel(A,B) :- Walk(A,B);
               Ride(A,B);
               Fly(A,B).
```

In response to a goal to get from A to B, Prolog will always "think about" walking before flying. There is nothing we can do about this algorithmically correct, but maddeningly counter-intuitive, behavior. One method to provide this system with some common sense is to use heuristics.

A Heuristic Search Solution

In an architecture supporting heuristics, the travel rule could simultaneously generate the following goals:

```
Goal(Walk(New York,London))
Goal(Ride(New York,London))
Goal(Fly(New York,London))
```

For these goals to exist simultaneously, they would have to be represented as data in the propositional database rather than being procedure calls that exist transiently on the stack, as in Prolog. We could then reason about these goals just as flexibly as if they were facts in Prolog's database. Using this approach, rules can be checked in response to new goal data, rather than in response to recursive procedure calls, as in Prolog.

The travel rule takes on a new look from this perspective. It is equivalent to these three rules:

```
Goal(Travel(A,B)),Walk(A,B) ->
     Travel(A,B)
Goal(Travel(A,B)),Ride(A,B) ->
     Travel(A,B)
Goal(Travel(A,B)),Fly(A,B) ->
     Travel(A,B)
```

When the goal to travel from New York to London is pursued, each of these rules responds in parallel, generating the following goals:

```
Goal(Walk(New York,London))
Goal(Ride(New York,London))
Goal(Fly(New York,London))
```

All three of these, in addition to the original goal, are represented as data in the propositional database. Given the possible methods of travel from New York to London, each represented as one of the above subgoals, how does the program determine what goal to consider first? Each time a goal is generated, the program can evaluate it according to its set of heuristics. Each heuristic can cast a vote in favor of pursuing a specific goal. The goal with the most votes is deemed the best. The inference engine then checks all rules that might achieve this goal, or any subgoal, and executes any applicable rules until none remain. By always pursuing the best goal, this inference engine performs a "best-first" search. We might use heuristics of the form

```
Heuristic1:
  Goal(Fly(A,B)),
  Distance_between(A,B,Distance),
  Distance > fly_threshold
  ->
  VoteFor(Goal(Fly(A,B))).

Heuristic2:
  Goal(Walk(A,B)),
  Distance_between(A,B,Distance),
  Distance < walk_threshold
  ->
  VoteFor(Goal(Walk(A,B))).
```

These are domain-specific heuristics that cause the program to first consider flying for long trips and walking for short trips.

A SEARCH STRATEGY

Being rules themselves, these heuristics can also generate subgoals, as do the rules described above.

For example, given

```
Goal(Fly(New York,London))
```

Heuristic1 would generate the subgoal

```
Goal(Distance_between(New
     York,London,??))
```

Heuristic2, given the same goal, would generate an equivalent subgoal. Thus, the single goal to determine the distance between New York and London would have two sources:

```
Goal(Fly(New York,London)),
     Heuristic1
Goal(Fly(New York,London)),
     Heuristic2
```

where a source is the combination of goal and rule that generates the subgoal.

The program could vote for any goal it created each time that goal was generated; that is, it could cast a vote in favor of a goal each time a source was added. Such a program would cause the system to strive to satisfy any goal that would allow it to evaluate or achieve a number of higher level goals. This is a domain-independent heuristic, as opposed to the previous heuristics, which are specific to domains in which flying or walking are relevant.

Using this heuristic would cause the inference engine to focus on establishing the distance between New York and London before focusing on walking, flying, or driving, each of which would have only one vote. After establishing the distance, which is presumably greater than both the riding and walking thresholds, the program votes for trying to fly, which dominates. If the distance were less than the walking threshold, a deciding vote would be cast in favor of trying to walk.

Such a strategy yields reasoning that more closely resembles our own intuitive approach to problem solving and results that are more in keeping with our commonsense expectations. The ability to apply any combination of heuristics to guide logical reasoning would dramatically assist in developing useful applications displaying more of what we normally think of as intelligence. ■

FOR MORE INFORMATION

Laird, J. E., and A. Newell. *A Universal Weak Method*. Computer Science Dept. Technical Report CMU-CS-83-141. Carnegie-Mellon University, 1983.

Haley, Paul V. *Opportunistic Backward Chaining*. Los Angeles, CA: Inference Corporation, 1987.

From micro to mainframe, Casio's got the hardware for your software.

At first glance, it may look like an ordinary calculator, but the Casio solar CM-100 is anything but. It's an extraordinary software tool that's as useful in programming an Apple™ as it is a mainframe IBM.™

The key to the CM-100's incredible flexibility is Casio's adjustable bit-size selector which can be set to suit any size computer up to 32 bits. And its block display which can, by scrolling blocks of 8 digits at a time, display up to a 32 bit word.

But there's much more to this pocket-size powerhouse. It can do base conversions from binary/octal/decimal/hexadecimal modes and can store in its memory numbers in any base. It also has Shift, Rotate, Arithmetic Shift and Boolean functions that include AND, OR, XOR and NOT.

Perhaps what is most extraordinary about the CM-100 though, is not how much it can do, but how little it costs to do it. The CM-100 is the only calculator that'll let you do all your software figuring for less than you'd figure to pay for an average ($25.00) textbook.

The more you work with computers—whatever their size—the more you need a CM-100. Whether you're a student or professional, it's the one piece of hardware that will make designing your software easier.

Apple and IBM are trademarks of the Apple and IBM Corporations.

CASIO®

Where miracles never cease

Casio, Inc. Consumer Products Division: 15 Gardner Road, Fairfield, NJ 07006 (201) 882-1493, Los Angeles (213) 803-3411

Circle 45 on Reader Service Card

Mathematical Reasoning

A Prolog program uses heuristic methods to solve equations

Leon Sterling

[Editor's note: *This article is adapted from chapter 22 of* The Art of Prolog *by Leon Sterling and E. Y. Shapiro, MIT Press, 1986.*]

SUCCESSFUL MATH STUDENTS do not solve equations by blindly applying axioms of algebra. Instead, they learn, develop, and use various methods and strategies. In this article, I'll describe and present key sections of an equation solver, written in Prolog, that models this heuristic behavior. [Editor's note: *The complete source code for the program is approximately 12K bytes long and is available on disk, in print, and on BIX. See the insert card following page 304 for details. Listings are also available on BYTEnet. See page 4.*]

The program is a simplified version of PRESS (which stands for Prolog equation-solving system), a system developed by Alan Bundy and coworkers in the mathematical reasoning group in the University of Edinburgh's department of artificial intelligence (see reference 1). The original version of PRESS, written in 1976 by Bob Welham, was intended as a research tool for investigating methods of controlling search—which is, by the way, an alternate definition of *heuristic*.

What does equation solving have to do with searching? Quite a lot, when you construe it as a search for a sequence of correct algebraic identities to apply to an equation to find the value of an unknown.

The Use of Prolog

Prolog makes it easy to express tasks involving symbolic manipulation. As an example, let's consider the task of deciding whether a given symbolic expression is a polynomial in a given term. For instance, is the expression $a^2 - 3a + 2$ a polynomial in the constant a?

A constant is a polynomial in any term X. X is a polynomial in itself. Sums, differences, and products of polynomials in X are polynomials in X. So, too, is a polynomial raised to a nonnegative integer power, and the quotient of a polynomial by a nonzero constant.

By this informal definition, $a^2 - 3a + 2$ is a polynomial in a because it is the sum of the polynomials $a^2 - 3a$ and 2. The expression $a^2 - 3a$ is a polynomial because it is the difference of the expressions a^2 and $3a$, which are similarly shown to be polynomials in a.

The top level of a Prolog program for recognizing polynomials is shown in listing 1a. It is no more (and no less) than a translation of the informal rules given above. The relation scheme of the program is `polynomial(expression, term)`; the relation is true if `Expression` is a polynomial in `Term`. One thing that makes the code so natural is its declarative quality. For example, the fact `polynomial(X,X)` says that a term `X` is a polynomial in `X` itself. The rule

```
polynomial(Poly1+Poly2,X) :-
  polynomial(Poly1,X),
  polynomial(Poly2,X).
```

says that the sum `Poly1+Poly2` is a polynomial in `X` if both `Poly1` and `Poly2` are polynomials in `X`. The colon-hyphen sequence `:-` can be read as "if," and the comma inserted between relations as "and."

Notice that only what is true needs to be specified in the program. For instance, it is not necessary to state explicitly that $\sin x$ is not a polynomial in x. That fact is taken care of implicitly in Prolog's computational model.

Another property that makes Prolog good for this kind of program is that the language (in most implementations) lets programmers use the natural algebraic syntax for writing mathematical expressions. Internally, `A+B` is a structure `'+'(A+B)`, where `'+'` is an uninterpreted function symbol, but this is irrelevant to the programmer.

What Is Equation Solving?

We can describe equation solving syntactically. Given an equation

lefthand side = righthand side

in an unknown x, the object is to produce an equivalent statement

x = *righthand side 1*

where *righthand side 1* does not contain x. This final equation is our solution. Two equations are equivalent if one can be transformed into the other by a finite number of applications of the rules of al-

continued

Leon Sterling is an assistant professor of computer science at Case Western Reserve University (University Circle, Cleveland, OH 44106).

gebra, known as *rewrite rules* (see reference 2).

Our equation solver handles three categories of equations in one unknown, exemplified as follows:

$$\cos x\,(1 - 2\sin x) = 0 \qquad (1)$$

$$x^2 - 3x + 2 = 0 \qquad (2)$$

$$2^{2x} - 5 \times 2^{x+1} + 16 = 0. \qquad (3)$$

In general, the program handles algebraic functions involving the operations +, −, ×, /, exponentiation to an integer power, and trigonometric and exponential functions. I'll briefly show how the solver handles each of the example equations.

The first step in solving equation (1) is factorization, which results in two simpler equations:

$$\cos x = 0 \qquad (1a)$$

$$1 - 2\sin x = 0. \qquad (1b)$$

A solution to either of these equations is a solution to the original equation.

An algorithmic method called *isolation* handles equations like (1a) and (1b), in which a single unknown occurs just once. The method repeatedly applies an appropriate inverse function to both sides of the equation until the single occurrence of the unknown is isolated on the left-hand side. For instance, the isolation algorithm handles equation (1b) as follows:

$$2\sin x = 1$$

$$\sin x = 1/2$$

$$x = \arcsin 1/2.$$

Equation (2) is a quadratic equation in x. Like any proficient high school student, the program solves it by a direct application of the quadratic formula.

Our equation-solving program uses a process called homogenization to solve equation (3). The aim of homogenization is to transform an equation involving logarithmic, exponential, or other transcendental functions into a polynomial in some term containing the unknown. For example, the key to solving equation (3) is to view it as a quadratic equation in 2^x:

$$2^{2x} - 5 \times 2^{x+1} + 16 = 0$$

$$(2^x)^2 - 10 \times 2^x + 16 = 0.$$

Solving by the quadratic method for 2^x gives two solutions of the form $2^x = Rhs$, where *Rhs* (the right-hand side) is free of x. Isolation techniques will then solve these equations for x.

Homogenization consists of four steps. The program parses the equation, collecting all maximal (i.e., not part of a larger term) nonpolynomial terms containing the unknown into an *offenders set*. For equation (3), the set would be $\{2^{2x}, 2^{x+1}\}$. The second step finds the reduced term—that is, the term in which the equation is a polynomial. The third step is to find rewrite rules that express each of the elements of the offenders set as a polynomial in the reduced term. Finding the rules guarantees that homogenization will succeed. The final step is performing the substitutions given by the rewrite rules.

The predicate `solve_equation(Equation,X,Solution)` is shown in listing 1b. It is the top-level relation of the equation solver. The relation is true if `Solution` is a solution to `Equation` in the unknown `X`. The predicate has four clauses, one for each of the four methods used in solving the three types of equations: factorization, isolation, polynomial analysis, and homogenization.

Each method has two parts: a condition testing whether the method is applicable, and the application of the method. I'll look briefly at how each method is implemented in Prolog.

Listing 1a: *Top-level code for recognizing polynomials.*

```
polynomial(X,X).
polynomial(Term,X) :-
    constant(X).
polynomial(Poly1+Poly2,X) :-
    polynomial(Poly1,X), polynomial(Poly2,X).
polynomial(Poly1-Poly2,X) :-
    polynomial(Poly1,X), polynomial(Poly2,X).
polynomial(Poly1*Poly2,X) :-
    polynomial(Poly1,X), polynomial(Poly2,X).
polynomial(Poly/Term,X) :-
    polynomial(Poly,X), constant(Term).
polynomial(Poly^N,X) :-
    integer(N), N>=0, polynomial(Poly,X).
```

Listing 1b: *Top-level code for equation solving.*

```
solve_equation(A*B=0,X,Solution) :-
    factorize(A*B,X,Factors),
    remove_duplicates(Factors,Factors1),
    solve_factors(Factors1,X,Solution).
solve_equation(Equation,X,Solution) :-
    single_occurrence(X,Equation),
    position(X,Equation,[Side|Position]),
    maneuver_sides(Side,Equation,Equation1),
    isolate(Position,Equation1,Solution).
solve_equation(Lhs=Rhs,X,Solution) :-
    polynomial(Lhs,X),
    polynomial(Rhs,X),
    polynomial_normal_form(Lhs-Rhs,X,PolyForm),
    solve_polynomial_equation(PolyForm,X,Solution).
solve_equation(Equation,X,Solution) :-
    homogenize(Equation,X,Equation1,X1),
    solve_equation(Equation1,X1,Solution1),
    solve_equation(Solution1,X,Solution).
```

Factorization

Factorization is the first method the equation solver attempts. The applicability test is trivial: The right-hand side of the equation must be 0, and the left-hand side must have the form `A*B`. In Prolog, the test is accomplished through unification (i.e., pattern matching) of the equation to be solved with the term `A*B=0`.

If the test succeeds, the program invokes the factorization operations. Each factor of the left-hand side is equated to 0 and solved recursively by the use of `solve_factors`. Single solutions are found by `solve_factors`, with alternative solutions being given on backtracking. This is described by the first clause in listing 1b.

Isolation

The second method tried by the solver is the isolation of the unknown on the left-

hand side of the equation. The second clause in listing 1b defines this method. The condition for applicability is that there be a single occurrence of the unknown X, checked by single_occurrence.

The isolation method proceeds to the predicate position, which calculates the position list of the unknown. Consider the equation $\cos x = 0$. The term $\cos x$ is the first argument of the equation, and x is the first and only argument in $\cos x$. The position list of x is therefore [1,1], as illustrated in figure 1a. Figure 1b shows the position list of x in the equation $1 - 2 \sin x = 0$, which is [1,2,2,1].

The next predicate in the isolation method is maneuver_sides(N,Equation,Equation1). It ensures that the unknown X appears on the left-hand side of Equation1. The argument N is the head of the position list and indicates the side of the equation in which the unknown appears (1 = left, 2 = right). The code for maneuver_sides consists of two facts, covering the cases that X is on the left-hand or right-hand side of Equation:

```
maneuver_sides(1,Lhs=Rhs,
                    Lhs=Rhs).
maneuver_sides(2,Lhs=Rhs,
                    Rhs=Lhs).
```

The final stage of the isolation method makes the unknown the subject of the equation by repeatedly applying the rewrite rules until the position list is exhausted:

```
isolate([N|Position],Equation,
          IsolatedEquation) :-
  isolax(N,Equation,Equation1)
  isolate(Position,Equation1,
          IsolatedEquation).

isolate([],Equation,Equation).
```

The rewrite rules, or isolation axioms, are specified by the relation isolax(N,Equation,Equation1) where N is an argument position, Equation is an expression before applying the rewrite rule, and Equation1 is the expression afterward.

Polynomial Analysis

The condition of the polynomial method, given by the third clause in listing 1b, is that both sides of the equation be polynomials in the unknown. If the condition is satisfied, the equation is converted to a polynomial normal form, and the polynomial solver goes to work.

The polynomial normal form is a list of tuples of the form (A_i,N_i), where each A_i is the coefficient of the corresponding, necessarily nonzero N_i. The tuples are sorted into decreasing order of N_i; for each degree i, there is at most one tuple. For example, the list $[(1,2),(-3,1),(2,0)]$ is the normal form for $x^2 - 3x + 2$.

Reduction to normal form occurs in two stages:

```
polynomial_normal_form(Polynomial,
X,NormalForm) :-
  polynomial_form(Polynomial,X,
                  PolyForm),
  remove_zero_terms(PolyForm,
                    NormalForm).
```

The code for polynomial_form closely follows the code for polynomial given in listing 1a. For each clause used in the parsing process, a corresponding clause gives the resultant polynomial. For instance, the polynomial form of a term x^n is $[(1,n)]$, which is expressed by the clause

continued

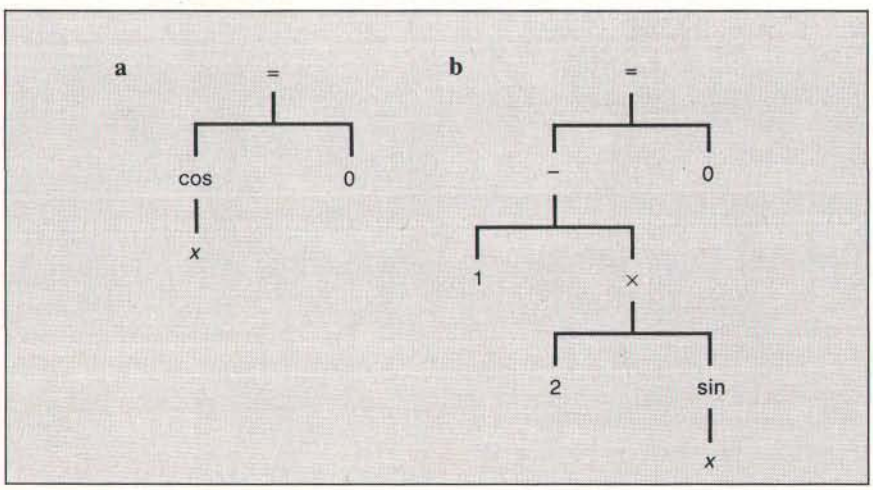


Figure 1: *A diagram showing how the position list for an unknown is generated.* **(a)** *In the equation cos* x *= 0, the position list for* x *is [1,1].* **(b)** *In the equation 1 − 2 sin* x *= 0, the position list for* x *is [1,2,2,1].*

```
polynomial_form(X^N,X,[(1,N)]).
```

Classical algorithms for handling polynomials apply to equations in normal form. The recursive clauses for `polynomial_form` manipulate the polynomials using simple algorithms to preserve this form.

Homogenization

The fourth clause in listing 1b shows the top-level homogenization logic. The original equation is transformed into a new equation in a new unknown. This new equation is then solved recursively, and its solution is used to obtain a solution to the original unknown.

Here's the code implementing the four stages of homogenization needed for solving equation (3) and similar equations:

```
homogenize(Equation,X,
           Equation1,X1) :-
  offenders(Equation,X,Offenders),
  reduced_term(X,Offenders,
               Type,X1),
  rewrite(Offenders,Type,X1,
          Substitutions),
  substitute(Substitutions,
             Equation, Equation1).
```

The code for `offenders` is similar to that for `polynomial`. A typical clause is

```
offenders(ExprA+ExprB,X,
                      Offenders) :-
  offenders(ExprA,X,OffA),
  offenders(ExprB,X,OffB),
  append(OffA,OffB,Offenders).
```

This clause states that the offenders set of the expression `ExprA+ExprB` is the result of concatenating the offender sets of `ExprA` and `ExprB`.

The code for offenders checks that there are at least two distinct elements in the offenders set. If there is only a single offender, homogenization will not be useful.

The predicate `reduced_term` finds a reduced term—that is, a candidate for the new unknown. Finding a reduced term proceeds in two stages: classifying the type of the offenders set, and finding a reduced term of that type.

```
reduced_term(X,Offenders,
                      Type,X1) :-
  classify(Offenders,X,Type),
  candidate(Type,Offenders,X,X1).
```

The program uses heuristic rules to classify the offenders set. In the example equation (3), the offenders set is of type exponential: All elements in the offenders set have the form A^B where A does not contain the unknown but B does.

Heuristic knowledge is also the basis for finding a suitable reduced term: If all the bases of the exponential terms in the offenders set are the same, say, A, and each exponent is a polynomial in the unknown X, then A^X is a suitable reduced term:

```
candidate(exponential,Offenders,
                      X,A^X) :-
  base(Offenders,A),
  polynomial_exponents(Offenders,
                       X).
```

The next step checks that each member of the offenders set can be rewritten in terms of the chosen reduced term. This involves finding a suitable rewrite rule. In this case, the applicable rules are

```
homogenize_axiom(exponential,
           A^(N*X),A^X,(A^X)^N).
homogenize_axiom(exponential,
           A^(X+B),A^X,A^B*A^X).
```

Extending the Solver

The equation-solving methods are readily adaptable to similar symbol-manipulation tasks, such as solving inequalities, proving identities, and solving simultaneous equations. Adding these capabilities is primarily a matter of adding rules covering the appropriate symbols.

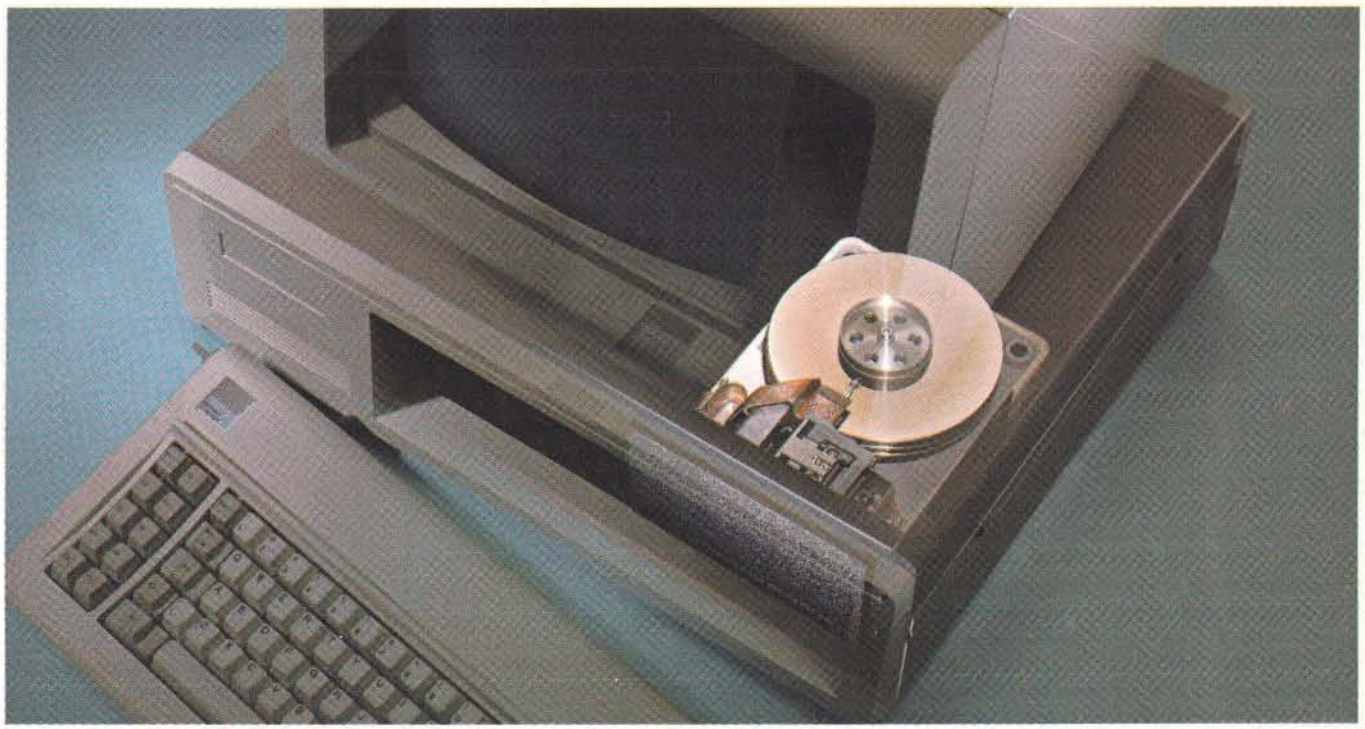
An interesting extension of PRESS (the large system from which the minisolver is derived) is the learning program LP, written by Bernard Silver (see reference 3). Starting with a subset of the methods of PRESS, LP was given worked examples of how to solve equations. LP analyzed the worked solutions and was able to build a new equation-solving method to solve similar equations. Essential to LP's success was the logical nature of the equation-solving program—for example, the distinction between testing for methods applicability and the execution of a method.

The range and variety of extensions to PRESS illustrate the importance of using a logic programming language like Prolog for heuristic applications. ■

REFERENCES

1. Sterling, L. S., A. Bundy, L. Byrd, R. O'Keefe, and B. Silver. "Solving Symbolic Equations with PRESS." In *Proceedings of EUROCAM 82, Springer Lecture Notes in Computer Science*, vol. 144, 1982, pages 109–116.
2. Bundy, A., and R. Welham. "Using Meta-Level Inference for Selective Application of Multiple Rewrite Rules in Algebraic Manipulation." *Artificial Intelligence*, vol. 16, 1981, pages 189–212.
3. Silver, B. *Meta-Level Inference*. New York: North-Holland, 1986.

THE DRIVE THAT MAKES YOUR COMPUTER WORTH LOOKING INTO.



We'll let you in on a secret. If the small computer you're using has a hard disc drive memory, chances are that drive was made by Seagate.

There's a reason for this—actually over 6 million reasons. (That's the number of hard disc drives Seagate has shipped to quality-conscious customers throughout the world.)

Why are we telling you this?

So you can be sure you get Seagate quality in your new computer, disc memory upgrade or add-on.

The name on the outside may be different, but now that you know the difference, make certain that the name on the inside is SEAGATE.

Seagate Technology, 920 Disc Drive, Scotts Valley, CA 95066. 800-468-DISC.

Seagate

Circle 245 on Reader Service Card

The $638,400 microcomputer commuter.

Scott Hunter, systems development manager, isn't the average commuter. When he arrives at his office today, he will issue purchase orders for micros and peripherals worth over $600,000. Scott is upgrading his company's PC equipment to speed communications between the field offices and headquarters. His company knows that Scott will select the most efficient, cost-effective and reliable models available. He is a **"Power User"** of micros at work and at home.

To keep his edge as a microcomputer expert, Scott reads BYTE, the authoritative micro technology magazine for the **"Power Reader."** BYTE readers have tremendous clout when it comes to micro-related purchases where they work. During the next 12 months, BYTE subscribers with technical titles like Scott's will buy or influence their companies' average purchases of $710,097 for micros, peripherals and software. It's a fact...the BYTE reader is *the* **"Power Buyer."**

In terms of buying influence, our "Scott Hunter" typifies the average BYTE reader with a technical job title, according to the *1986 Hardware and 1987 Software Purchasing Influence Studies.*

Are you putting the "Power of BYTE" to work for your micro products? To find out how...call your BYTE Advertising Sales Consultant today.

BYTE
THE SMALL SYSTEMS JOURNAL

One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281

McGraw-Hill

Neural-Network Heuristics

Three heuristic algorithms that learn from experience

Gary Josin

THE ACCELERATING PACE of high-performance hardware development and the emergence of parallel-machine architectures signal the need for a new approach to designing software. We need a new software paradigm that cannot only take advantage of hardware advances but also can deal with circumstances the software's writer could not have foreseen.

What we need is software that can learn from experience. A concept that lends itself well to the heuristics of learning from experience is the neural-network model. Several algorithms have been developed to test the validity of neural-network heuristics. This article explores three of these algorithms. [Editor's note: *For an explanation of another of the neural-network algorithms, see "Back-Propagation" by William P. Jones and Josiah Hopkins on page 155.*]

Before delving into the algorithms, however, let me explain why the neural-network paradigm holds much promise.

Computational Richness

When performing intelligent information processing, such as image recognition, language comprehension, or combinatorial optimization, the human brain outperforms even the fastest digital computer. This is primarily because of the fundamental difference in information-processing capabilities of digital computers and human brains.

Digital computers can be programmed for intelligent tasks. The problem is that the algorithmic solution to many information-processing tasks is far too complex to be programmed.

But that's not the only problem. Even if a particular application has a clear and concise solution, many algorithms are too computationally intensive to allow a digital computer to find a solution in any reasonable period of time.

The computational richness of the human brain comes from its large number of "living neurons" that are connected to each other by a complex network of synapses. Neural-network designs use the structure of the human brain to try to emulate the way intelligent information processing occurs within a living brain.

In software simulations, the basic structure of a neural network is very simple. It consists of an array of elements usually called "neurons," interconnections between these neurons, and some I/O scheme. The intelligent information properties of the network arise from the topology of the network and in the learning rules of the neurons.

The topology of a neural network describes factors such as how many interconnections there are for each neuron; that is, is each neuron connected to a few other neurons, to many other neurons, or to all other neurons in the network? If a neuron is not connected to all other neurons, does it connect to its nearest neighbor neurons, to distant neurons, or to some combination of near and distant neurons? Finally, and more importantly, what is the neural network trying to internally represent within a particular topological structure?

The learning rules for the neurons describe how each neuron interprets the information coming in from all the neurons connected to it and, on the basis of that interpretation, what signal to distribute to the rest of the network. There are many different learning rules based on a number of factors, such as dependence on the previous state of the neuron, stable or varying thresholds, and the particular functions used to sum the input signals.

A model of a neural network uses a particular topology, a type of neuron, and a learning rule for the interactions and interrelations of its fundamental constituents—the neurons and their connections. Particular models give a description of a neuron's actual input and output and the mapping between the input and output.

Soviet mathematician A. N. Kolmogorov has proved a theorem (see reference 1) that neural-network models can learn to approximate any continuous mapping—while minimizing error in the mapping in a least-mean-square sense—based only on the example mapping. In fact, a network can even learn to adapt to unpredictable changes in its inputs.

If a particular neural-network model's computational capabilities are more effective at performing information-processing operations than computer-based approaches, this makes it practical for the construction of neural-network machines, regardless of whether neural networks actually emulate the human brain.

continued

Gary Josin is the president of Neural Systems Inc. He can be reached at 2827 West 43rd Ave, Vancouver, B.C., Canada V6N 3H9.

Neural networks process information in novel ways. In fact, given a threshold number of connections between a set of simple neurons, a form of *self-organization* takes place, and from this organization collective computational properties emerge, such as association, generalization, differentiation, preferential learning, optimization, and fault tolerance. The use of these properties holds promise for developing solutions to problems that have intractable or unknown algorithms or are too computationally intense. The above properties are evident in the three neural-network models described and illustrated below.

General Equation

The different models and combinations of models of neural networks can be derived from the following equations:

$$dU(i)/dt = G[J(U(i)), [Sj]T(i,j)f(U(j))] \quad (1a)$$

where

$$dT(i,j)/dt = g(T(i,j),U(i),U(j)). \quad (1b)$$

U(i) is the input to neuron (i); G() is a function that describes the output of neuron (i); [Sj] denotes the sums over the j interconnections to neuron (i); J() is a function describing the coupling of a neuron to itself; f() is a function that describes the input from connection (j) to neuron (i); T(i,j) is an interconnection value between neuron (i) and neuron (j); and g() is a function that describes how to assign an interconnection value.

Particular network models and their heuristics can be derived from this general neural-network equation. Here is a brief description of the three models under examination:

- The *associative memory* model exhibits many of the computational capabilities of neural networks, such as association. This model can be used for simple visual processing (see reference 2).
- The *optimization* model offers solutions to very difficult combinatorial optimization problems, such as the well-characterized traveling salesman problem (see reference 3).
- The *self-organization* model is effective for dealing with problems that have a complicated or impossible-to-define algorithm, and it can be used for robotic control (see reference 4).

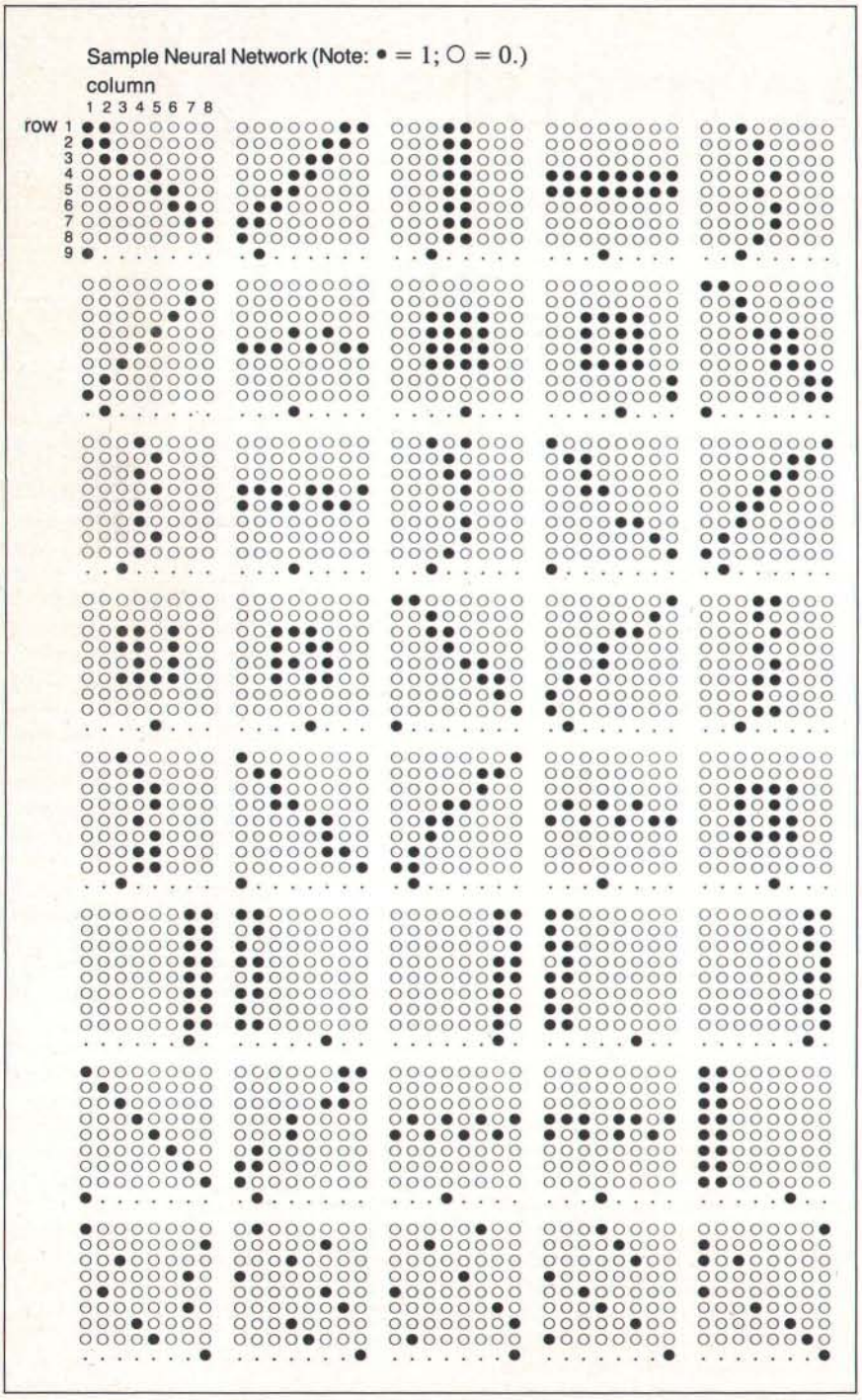


Figure 1: *The original patterns for a sample neural network designed to illustrate the associative memory property. (Note: • = 1; ○ = 0.)*

The Associative Memory Model

For an example of a simple visual-processing application and an introduction to the computational properties of a neural network, consider the set of patterns in figure 1. These patterns constitute a database of simple "primal" images. These images are a simple list of eight rows of eight numbers with values of 0 or 1. The ninth row contains a single 1.

The ninth row categorizes the patterns; for example, the pattern in the top left-hand corner of figure 1 has a single 1 in the first column of row 9, whereas the pattern directly beside it to the right has a 1 in the second column of row 9. A 1 in the first column of row 9 categorizes a pattern as a top left- to bottom right-hand corner diagonal line. A 1 in the second column of row 9 categorizes a pattern as a top right to bottom left diagonal. The other patterns are similarly categorized. This process of categorizing patterns is a case of supervised learning. A teacher

continued

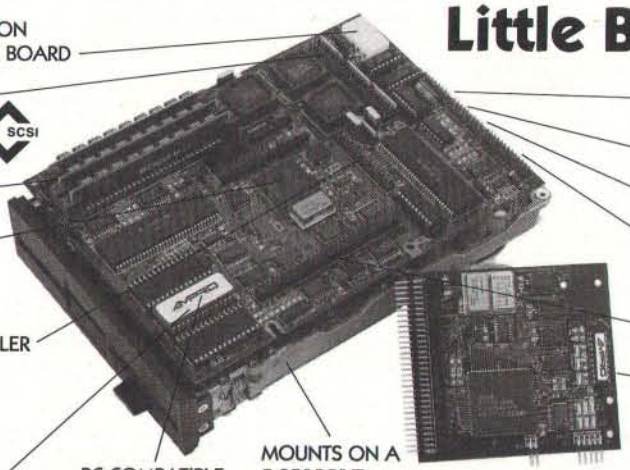
Reliable, Cost Effective Solutions for Computerization

World's smallest PC — and CMOS too!

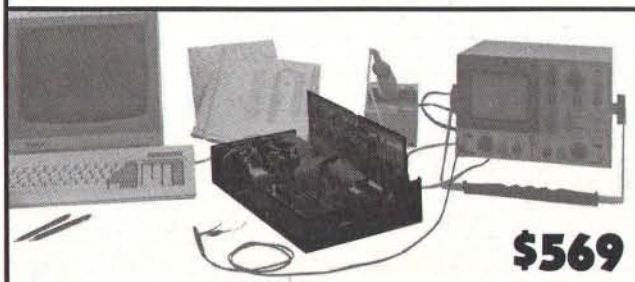
A Motherboard and 4 Expansion Cards in the Space of a Half-Height 5-1/4" Disk Drive!

from **$395**
(Qty 100, $336)

Little Board™/PC



- 3 WATTS! 5 VOLT ONLY OPERATION ± 12 V GENERATED ON BOARD
- SCSI BUS OPTION (HARD DISK, ETC)
- 256 K RAM (512 K, 768 K OPTIONS)
- POWERFUL V40 CPU
- FLOPPY DISK CONTROLLER (3.5"/5.25", 360 K/720 K, 1.2 MB)
- UP TO 128 K EPROM/RAM/NOVRAM BATTERY BACKED RT CLOCK
- PC COMPATIBLE ROM-BIOS
- MOUNTS ON A 5.25" DRIVE (5.75"x8"x1")
- 2 RS232C SERIAL PORTS
- SPEAKER PORT
- KEYBOARD PORT
- PARALLEL PRINTER PORT
- PC BUS
- 4 MODE VIDEO CONTROLLER OPTION FITS ENTIRELY WITHIN BOARD DIMENSIONS



$569

Development Chassis/PC™
"Known Good" PC bus project development environment for Little Board/PC (not included).

$179

CMOS Video Controller
4-mode CMOS video controller for Little Board/PC.

$195
(Qty 100, $166)

INCLUDES CP/M!™ DRI

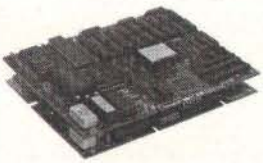
Little Board™
World's least expensive single board system.

$395
(Qty 100, $336)

MS-DOS Microsoft Corp.

Little Board™/186
High performance single board MS-DOS system.

from **$189**



Expansion/186™
Multi-function expansion for Little Board/186. I/O, Serial, RAM, and Math Options.

$119

Project Board/186™
Prototype adapter for 80186 based projects and products.

$99

Project Board/80™
Prototype adapter for Z80 based projects and products.

Z80 TM ZILOG

Distributors • Argentina: Factorial, S.A. 41-0018 • **Australia:** Current Solutions (613) 720-3298 • **Austria:** International Computer Applications GMBH 43-1/45 45 01-0* • **Brazil:** Computadores Compuleader (41) 262-4866 • **Canada:** Tri-M (604) 438-0028 • **Denmark:** Danbit (03) 66 20 20 • **Italy:** Microcom (6) 811-9406 • **Finland:** Symmetric OY 358-0-585-322 • **France:** Egal Plus (1) 4502-1800 • **Germany, West:** IST-Elektronik Vertribes GmbH 089-611-6151 • **Israel:** Alpha Terminals, Ltd. (03) 49-16-95 • **Spain:** Hardware & Software 204-2099 • **Sweden:** AB Akta (08) 54-20-20 • **Switzerland:** Thau Computer AG 41 1 740-41-05 • **UK:** Ambar Systems, Ltd. 0296 435511 • **USA:** Contact Ampro Computers Inc.

AMPRO
COMPUTERS, INCORPORATED

67 East Evelyn Avenue • Post Office Box 390427, Mountain View, CA 94039 • (415) 962-0230 • TLX 4940302

has to categorize the patterns.

The associative memory model can be configured as an associative "memory" to encode/decode these primal images. If each neuron represents a bit (1 or 0), a network of 72 neurons can map this particular set of patterns in the form of an N-by-N connection matrix T(i,j). Then, when presenting a pattern U(i) as input to the neurons, the network evokes the desired memory behavior.

For this particular application, the associative memory model uses two-state neurons. The neurons' outputs take on values of either a 1 or a 0, depending on the inputs from all other interconnected neurons. The total input to neuron (i) is then

$$E(i) = \text{total input to (i)} = \{Sj\}\{Sl(i)\}T(i,j,l(i)),$$

where {Sj} denotes the sum over all other neurons, and {Sl(i)} denotes the sum over l(i) and defines the length of the memory of neuron (i).

Given the total input, neurons change their output according to a threshold rule:

$$G[E(i)] = 1 \text{ if } E(i) > Th(i),$$
$$G[E(i)] = 0 \text{ if } E(i) <= Th(i),$$

where Th(i) is the threshold of neuron (i).

This model uses a modified Hebbian learning rule (see reference 5) that describes how patterns are mapped between neuron (i) and neuron (j):

$$T(i,j,l(i)) = (2U(i,l(i))-1) *(2U(j,l(i))-1).$$

For N two-state neurons, equations (1a) and (1b) then simplify to

$$U(i) = G[\{Sj\}\{Sl(i)(2U(i,l(i))-1) *(2U(j,l(i))-1)U(j)].$$

This network operates in two phases. In the first phase, the 40 patterns in figure 1 are input to the network to assign the connection matrix T(i,j) between the neurons. In the second phase, the performance of the network is tested by presenting patterns to the input neurons. The N outputs then describe how the network performs information processing.

Figure 2 shows how the network performs on a set of input patterns in the second phase after the connection matrix T(i,j) has been assigned. The sequence shows the mapping of the network after entering a particular input pattern. The input patterns in this sequence were selected so that they would get progressively further away from resembling the original pattern shown in figure 1. Figure 2 also shows the total excitation on the neuron that categorizes that particular pattern. As the figure shows, the categorizer neuron is less excited as the input pattern to the network gets further away from resembling an original pattern. In this way, a categorizer neuron's excitation is a measure of how close an input pattern is to a particular original pattern.

Figure 3 shows how a network performs computation on confusing and ambiguous input patterns. The last pattern in the sequence shows how the network has responded to a confusing input pattern that was constructed from 60 percent of one pattern and 40 percent of another. The network maps this confused pattern to the closest original pattern.

Figure 3 also shows the network's performance for ambiguous input patterns

continued

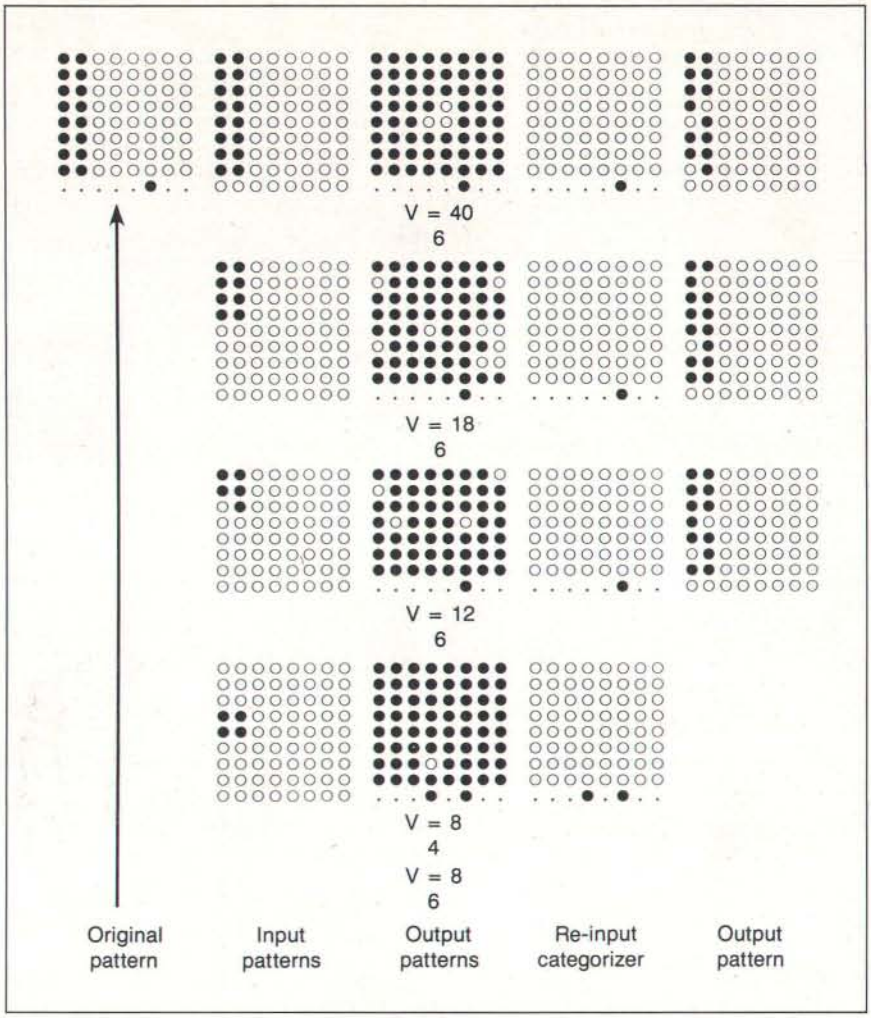


Figure 2: *Inputs to the original pattern of the network produces output patterns and an input categorizer.*

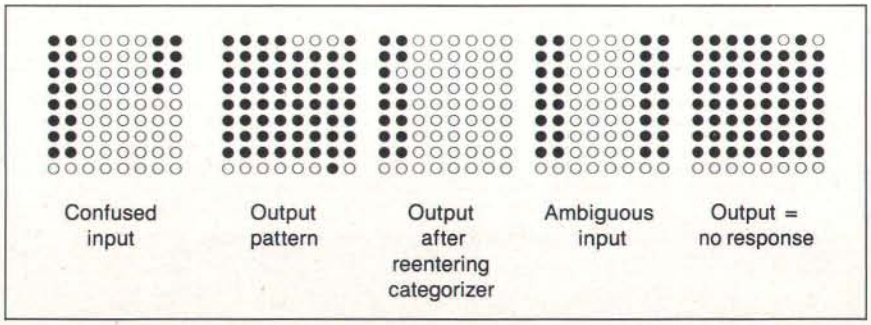
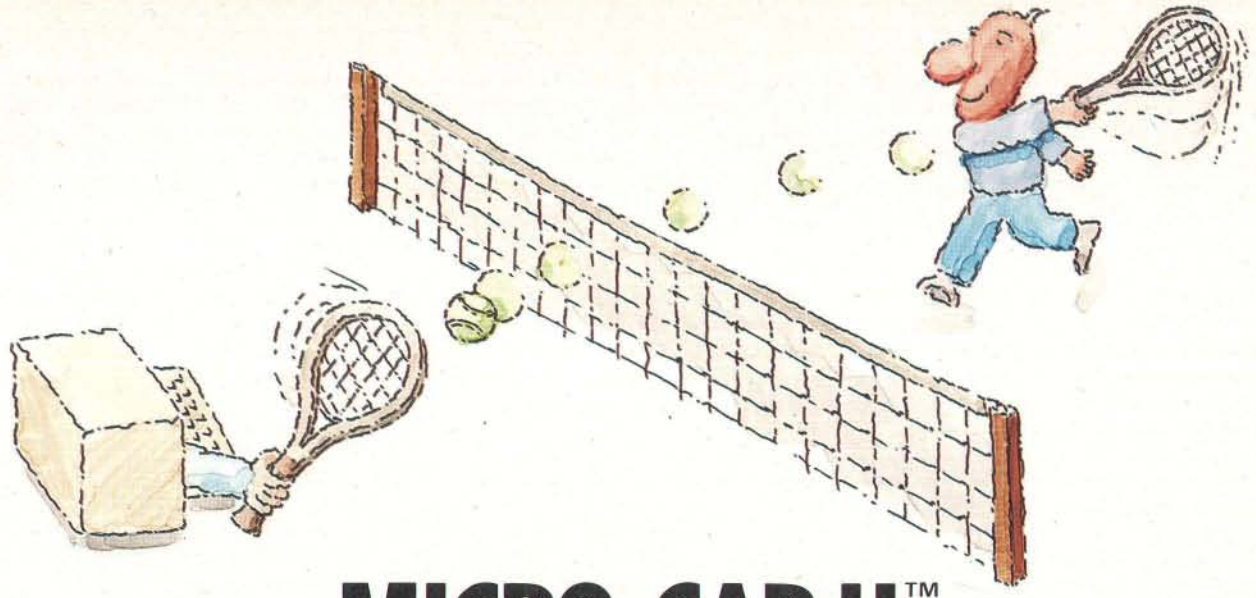


Figure 3: *The output patterns generated by confused and ambiguous input patterns.*

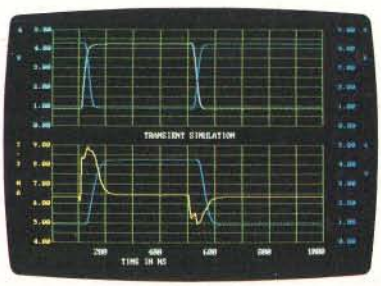


MICRO-CAP II.™

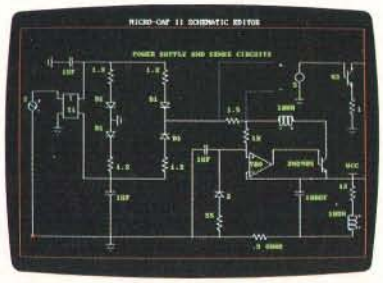
The CAE tool with fully interactive analog simulation for your PC.

Spectrum Software's MICRO-CAP II® is fast, powerful, and feature rich. This fully interactive, advanced electronic circuit analysis program helps engineers speed through analog problems right at their own PCs.

MICRO-CAP II, which is based on our original MICRO-CAP software, is a field-proven, second-generation program. But it's dramatically improved.



Transient Analysis



Schematic Editor

MICRO-CAP II has faster analysis routines. Better resolution and color. Larger libraries. All add up to a powerful, cost-effective CAE tool for your PC.

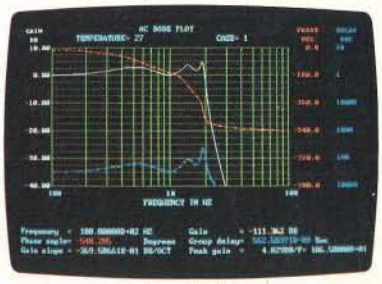
The program has a sophisticated integrated schematic editor with a pan capability. Just sketch and analyze. You can step component values, and run worst-case scenarios—all interactively. And a 500-type* library of standard parts is at your fingertips for added flexiblity.

MICRO-CAP II is available for IBM® PCs and Macintosh.™ The IBM version is CGA, EGA, and Hercules® compatible and costs only $895 complete. An evaluation version is available for $100. Call or write today for our free brochure and demo disk. We'd like to tell you more about analog solutions in the fast lane.

- Integrated schematic editor
- Fast analysis routines
- High-resolution graphic output
- Standard parts library of 500* types

*IBM versions only.

- Transient, AC, DC, and FFT routines
- Op-amp and switch models
- Spec-sheet-to model converter*
- Printer and plotter* hard copy



AC Analysis

spectrum

1021 S. Wolfe Road, Dept. E
Sunnyvale, CA 94087
(408) 738-4387

Circle 259 on Reader Service Card

that are constructed from 50 percent of one pattern and 50 percent of another. The network matches this ambiguous input to no response. If the network had been trained on one of the patterns more often than the other, it would have developed a preference for that particular pattern. This is called *preferential learning*.

Since input patterns are stored in a distributed fashion throughout the network, a large percentage of neurons and/or their interconnections can be destroyed, and the network can categorize input patterns as before. This gives the network *fault tolerance*. When the associative memory model is minimally connected to map only one pattern, it acts like a filter and can *differentiate*. In other words, the network can discriminate that particular input pattern from all other input patterns.

On the other hand, as the network comes closer to being fully connected, the network can map or *associate* variations of particular patterns.

The Optimization Model

As an example of a neural network that could produce solutions to optimization problems, consider the map of locations in figure 4. For N locations on a map, calculate all closed paths that visit each location once, then pick that combination of paths that produces the overall shortest path length. There are N! possible solutions, and this number gets large very fast. For example, for 30 locations there are 10^{30} possible paths. On a present-generation computer, this task is computationally intensive. This is an example of a problem that has a well-characterized algorithmic solution. The goal for this model is to find a less intensive solution.

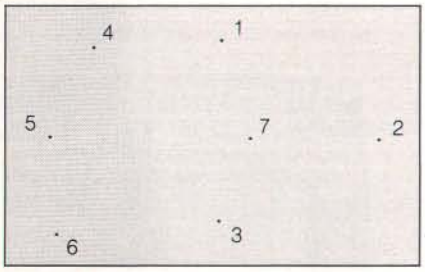


Figure 4: *The seven map locations illustrating the well-known traveling salesman problem.*

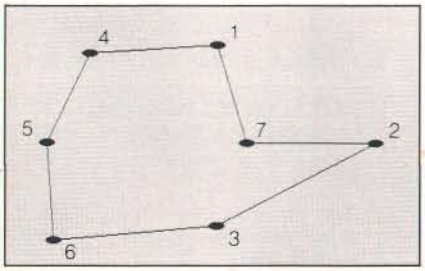


Figure 5: *A solution for the traveling salesman problem, as found by a neural network using the optimization heuristic.*

This model optimizes for path minimization and uses an equation for dU/dt as follows:

$$dU(i)/dt = -U(i)/R(i)C(i) + [Sj]T(i,j)f(j,U(j))/C(i) + I(i),$$

where

- U(i) is the input to neuron (i),
- I(i) is the current injected into neuron (i),
- RC is the time constant of the neuron (i), and the resulting U(i) is processed by $G[U(i)] = (1 + \tanh(A(U(i) - Th(i))))/2$, where G[U(i)] is the output of the neuron, Th(i) is the threshold of neuron (i), A is the gain.
- T is the connection matrix defined from the learning rule

$$T(i,j) = -A\,\mathrm{delta}(x,y)(1 - \mathrm{delta}(i,j)) - B\,\mathrm{delta}(i,j)(1 - \mathrm{delta}(x,y)) - C - D\,d(x,y)(\mathrm{delta}(j,i+1) + \mathrm{delta}(j,i-1)),$$

where delta(i,j) = 1 if i=j; otherwise, delta(i,j) = 0; and A, B, C, and D are coefficients that are general constraints for any particular problem of this type.

The first two terms of the expression for T(i,j) guarantee only one visit to each location and that a location can be in only one position in the tour. The fourth term is a constraint that controls which of the N! possible final states is the best path.

Figure 5 shows a solution found by the optimization model. The network found near-best solutions to this problem—not the exact solution.

In many situations, finding one of the best paths very rapidly is better than computing the optimal solution to the problem.

The Self-Organization Model

The final model is an example of a neural network that can learn to approximate a mapping for robotic control strategy based only on randomly sampled inputs from a two-dimensional space. This model uses neurons that operate in the linear regime as follows:

$$U(i,t+1) = [Sj](T(i,j)U(j,t)),$$

where the learning rule evolves the system by the following equation:

$$dT(i,j)/dt = a(t)[U(j,t) - T(i,j,t)], \quad (2)$$

depending on whether neuron (i) is in the topological neighborhood of the neuron that best matches a particular input U(j). During the learning phase, the connections T(i,j) are adjusted so that their values form a topological image of the inputs. When a position U(j) is input to the network, the T(i,j) value that is maximally active for that particular input acts like an image of that input.

Consider a robotic arm that is moving around randomly in a two-dimensional plane. The arm is a line segment that can change its angle and length. As the arm moves in the plane, its end effector is located to a random position in the x,y plane. The connections are thought of as internally representing 400 coordinate pairs in the plane. A randomly selected coordinate pair from the arm's location sensor is fed as input to the network. The connection that becomes the most active is considered the image of that particular location. This connection to a particular neuron defines the topological neighborhood.

As described by equation (2), once the neighborhood is defined, all of the neurons within it change their connection strengths by an amount directly proportional to how far away it is from the randomly selected coordinate pair. After the robot arm has sampled a sufficient number of uniformly distributed coordinate pairs over the two-dimensional surface, the network's connections become ordered according to their mutual similarity. The end result is that a particular neuron becomes sensitive to a particular connection that in turn becomes most active in response to a particular randomly sampled coordinate, forming an image of the two-dimensional space.

Figures 6 to 10 show how well the network forms the image of two-dimensional space as the number of randomly selected coordinate pairs used to produce the mapping increases. Notice that as more points are sampled, the lattice of lines is beginning to show the emergence of the topology-conserving property of the connections. The connections converge to form an ordered map of a two-dimensional space. In figure 10, a well-formed map has emerged.

Figure 11 shows a plot of random coordinate pairs that are totally different from any of the pairs that were used in forming the topological map. These previously unseen positions are generalized as a nearest-neighbor match.

Neural-Network–Based Systems

Self-organization lets neural-network–based systems adapt to unpredictable changes in their environment. The network learns directly from its environment so that no extra constraints are required.

continued

Get a new handle on your business with SBT.

Now Available for SCO XENIX

Now you can handle up to 254 users, all working in the same data files, with the SBT MultiNet Database Accounting Library. The accounting software written in dBASE III PLUS.®

So whether your business is large or small, you can grow to the limits of the most advanced PC networks available.

When you want that special report, or your business needs something we didn't think of, you can quickly and easily modify our programs to meet your needs exactly (because our dBASE source code is included).

And if you don't have time to make the changes yourself, there's a nearby consultant who can make them for you.

So if your company has two users or two hundred and fifty, you can add customers, update records, and have as many people enter orders as it takes to keep your business growing.

Isn't it nice to know there's software you can't outgrow? The SBT MultiNet Database Accounting Library.

Now you can get a new handle on your business.

Call today for our demo disk, brochure and for the name of the SBT consultant in your area. (415) 331-9900. In Canada, call MSR, (416) 598-4982.

THE SBT DATABASE ACCOUNTING LIBRARY.

dProfessional	Time & Billing	$395
dOrders	Sales Order Processing	$295
dInvoice	Billing/Inventory Control	$295
dStatements	Accounts Receivable	$100
dPurchase	Purchase Order	$295
dPayables	Accounts Payable	$395
dPayroll	Payroll/Labor	$395
dLedger	General Ledger/Finance	$395
dAssets	Asset/Depreciation	$295
dProject	Project/Job Accounting	$395
dProperty	Tenant/Unit Management	$395
dMaterials	Manufacturing Planning	$395
dMenu/Backup	Menu/Backup	$ 65

MultiNet versions $200 additional per module

One Harbor Drive
Sausalito, California 94965
(415) 331-9900 Telex 9102404708

SBT CORPORATION

Macintosh, Atari and compiled versions are available. dBASE III PLUS is a registered trademark of Ashton-Tate, Inc. Macintosh is a trademark of Apple Computer, Inc. Atari is a registered trademark of Atari Corp. XENIX is a registered trademark of Microsoft Corp. SCO is an abbreviation of the Santa Cruz Operation. SBT Database Accounting Library and MultiNet are trademarks of SBT Corp. © 1987, SBT Corporation.

Circle 239 on Reader Service Card

Consequently, this property allows desired functionality independent of any knowledge of the physical parameters of a particular system. A neural system has no knowledge of equations, nor does it learn any.

Self-organization enables neural-network–based systems to make up for inaccuracies in mechanical structures and inaccurate sensor readings as they naturally degrade. Present-day systems that

continued

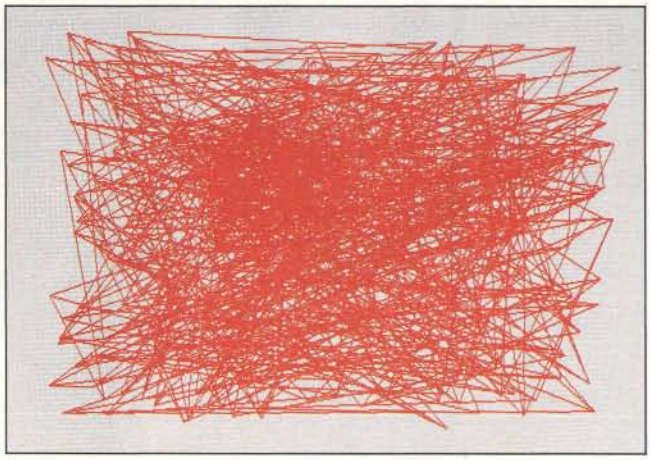


Figure 6: *A map of the two-dimensional space for a sample robotic-arm matrix, plotted using randomly selected coordinate pairs.*

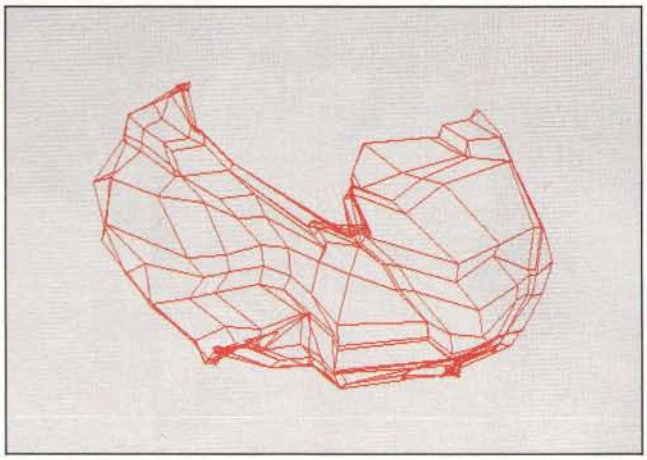


Figure 7: *The matrix begins to define a two-dimensional surface as the number of points increases. Here, the number of defined points is 50.*

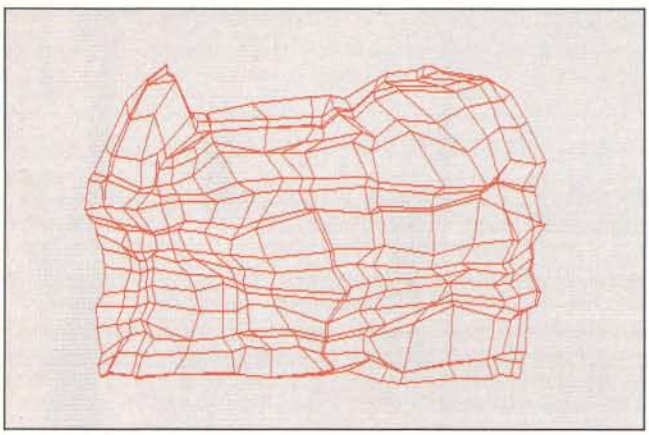


Figure 8: *With 250 points defined, the matrix nearly has a recognizable shape.*

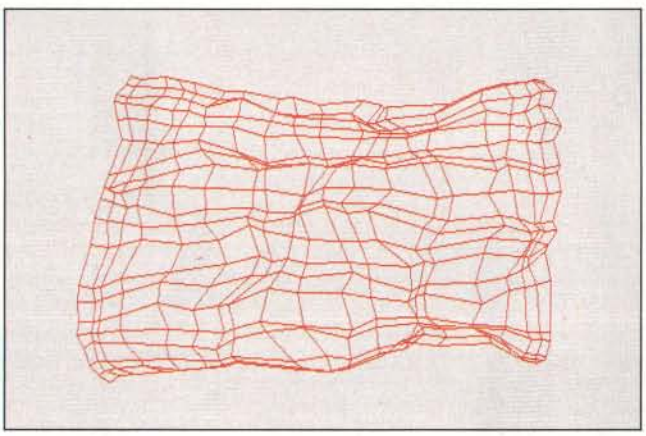


Figure 9: *The matrix still looks irregular with 500 points defined.*

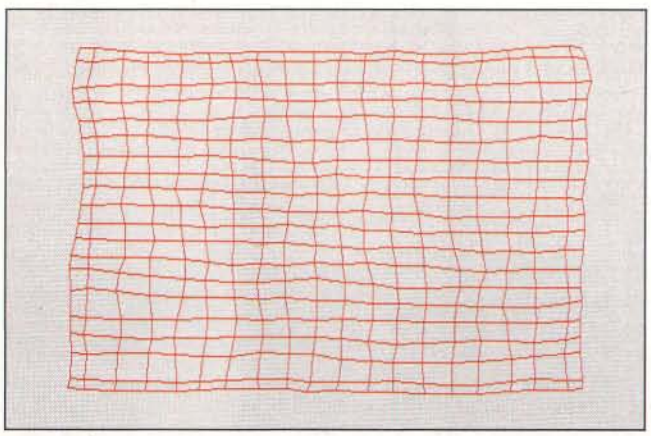


Figure 10: *It requires the specification of 5000 points to clearly define the matrix.*

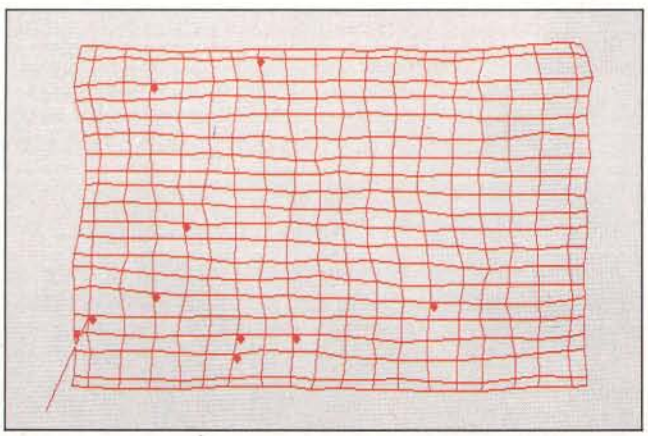


Figure 11: *After the matrix is defined, it is possible to place points within the two-dimensional space of the matrix that are different from the points used to define the area.*

Order Status, Technical & Other Info. (602) 246-2222

Call for programs not listed

WAREHOUSE DATA PRODUCTS

SPECIAL
WORD PERFECT
$195

TOLL-FREE ORDER LINE 1-800-421-3135

FREE SOFTWARE!
Purchase over $100 and receive one of these disks absolutely FREE! Purchases over $250 get two free disks, over $400 get three, or get all four disks when your purchase is over $500! **1) MIXED BAG** — A great assortment of utilities and games all packed on one disk. **2) PC-WRITE** — Try this famous feature packed word processor. It's a winner! **3) FONT-SET** — Lets you set popular fonts like bold, underline, etc. on most late model printers from Citizen, Epson, NEC, Okidata, Panasonic, Star, Toshiba, etc. You can even use your printer like a typewriter! **4) ABC-LIST** — Great mailing list program! Sort on any field, do qualified searches, print reports and mailing labels, and more!

— SOFTWARE —

ACCOUNTING

BPI AP, AR, PR, GA	$169 ea.
Cyma	Call
Dac Easy Accounting	39
Dollars & $ense	94
Managing Your Money 3.0	117

COMMUNICATION PROGRAMS

Carbon Copy Plus	115
Crosstalk	89
Remote	89
Smartcom II	83

DATA BASE MANAGERS

Clipper	380
Clout 2	Call
Condor III	310
Knowledgeman II	Call
Powerbase 2.2	169
Q&A	Call
Quickcode	138
Quicksilver	295
Quickreport	138
Revelation	469
R: Base System V	425

EDUCATIONAL

Flight Simulator	28
Turbo Tutor II	25
Typing Tutor III	Call

GRAPHICS

Chartmaster	Call
Energraphics 2.01	294
In-A-Vision	275
Microsoft Bus Mouse	106
Microsoft Chart 3.0	229
Microsoft Serial Mouse	119
Newsroom	31
OPTI Mouse W/DR Halo II	96
Printshop	33
Signmaster	Call

INTEGRATED

Ability	59
Enable	355
Smart Software	Call

LANGUAGES

Lattice C Compiler	$242
Microsoft C Compiler	249
Microsoft Fortran 4.0	255
Microsoft Macro Assembler	84
Microsoft Pascal Compiler	166
Microsoft Quick Basic 3.0	55
Ryan McFarlan Fortran	305
Ryan McFarlan Cobol	479
Turbo Basic	55
Turbo C	55
Turbo Pascal w/8087 + BCD	55

PROJECT MANAGER

Harvard Total Project II	349
Microsoft Project	219
Super Project Plus	Call
Timeline 2.0	242

SPREADSHEET

Microsoft Multiplan	108
Spreadsheet Auditor 3.0	82
Supercalc 4	Call
VP Planner	49

UTILITIES

Copy II PC	19
Copywrite	39
Desqview 2.0	72
Double Dos	30
Fastback	85
Graph in the Box	55
Homebase	39
Microsoft Windows	55
Norton Utilities 3.1	48
Prokey 4.0	70
Q DOS	49
Sidekick (unprotected)	55
Sideways 3.1	39

WORD-PROCESSING

Easy Extra	88
Microsoft Word	Call
Multimate Advantage II	Call
Volkswriter 3	139
Webster Spellcheck	37
Word Perfect	195
Wordstar	162
Wordstar Propac	233
Wordstar 2000+	206

— HARDWARE —

ACCESSORIES

Copy II PC Board	75
150 watt power supply	69
Mini Micro Parallel Print Buffer	69
Masterpiece	88
Masterpiece Plus	99

BOARDS

AST Advantage Premium	Call
AST Premium Sixpac	Call
AST Sixpac	145
Hercules Color Card	145
Hercules Graphics +	182
Intel Above Boards	Call
J Laser (Tall Tree)	Call
J Ram 3 (Tall Tree)	169
J Ram 3 AT (Tall Tree)	207

COMPUTERS

AZ 386
80386-16 Micro Processor, 1 MB of Ram, Teac 1.2 MB disk drive, 220 watt power supply, 6 layer mother board, RT keyboard **$2995**

AZ TURBO XT
IBM Compatible Computer, 135 watt power supply, 1 brand name floppy disk, 1 parallel port, 1 serial port, 1 game port, PC keyboard, 640K Ram, 8 expansion slots, 8088-2 processor ... **$519.00**

AZ TURBO AT
IBM AT Compatible, 512K, 6 & 8 MHZ, keyboard, graphics card, 220 watt power supply, MS/DOS 3.2 GW Basic **$1025**

AST 286 PREMIUM COMPUTER
512K, expandable to 2MB on the system board, RT enhanced style keyboard, parallel, serial and clock, 1.2 MB floppy disk drive, 7 expansion slots, two 32 bit fastram slots, DOS 3.1 & Basic
1 year warranty ..... **Call**

EGA BOARDS

GBI Board	Call
Paradise Auto Switch 480 EGA Card	290
Quad EGA Plus	Call
Vega Deluxe	299

EGA MONITORS

AMDEK 722	455
Casper EGA	Call
NEC Multisync	559

HARD DRIVES

AZ 20 MB Hard Card	425
AZ 30 MB Hard Card	Call
Filecard 20 MB	499
Maynard 20 MB Hard Card	Call
Plus Hardcard 20MB	Call
Seagate 20 MB Int. w/cont.	299
Seagate 30 MB Int. w/cont.	Call
Seagate 30 AT Int.	515

KEYBOARDS

Keytronics 5151	149
Keytronics 5153	245
RT Style Keyboard	89

INCREDIBLE VALUES
Nationally advertised boards for IBM PC and most compatibles at give away prices.

Keyboards (similar to 5151)	$79
Monochrome Board w/printer port (similar to Hercules Graphics)	$79
Expansion Board 0 to 576K	$42
Multifunction Board w/game port (similar to AST six pack)	$79
Four Drive Floppy Controller	$39
Color Card w/o printer port	$69
Color card w/printer port	$79

MODEMS

Everex 300/1200	89
Hayes 1200	Call
Hayes 1200B	Call
U.S. Robotics Courier 2400	335
U.S. Robotics Passwd. 1200	180

MONITORS

AMDEK 410 Amber	157
AMDEK 600	339
Magnovox Color RGB	Call
Princeton Max 12	138
Samsung TTL Amber	72
Samsung TTL Green	70
Samsung Color w/tilt/turn	Call

PRINTERS

CANON LASER
CITIZEN

MSP-10	255
MSP-15	324
MSP-20	294
Premiere 35 Daisywheel	459

EPSON - Call on all models

LASER IMAGE 2000	Call

NEC

NEC P5XLP	840
NEC P7 Parallel	619
NEC 8850	1059
NEC P6 Parallel	439
NEC P960XL	1035
NEC Laser	Call

OKIDATA - Call on all models
PANASONIC

1080-I	155
1091-I	179
1092-I	310
1592	392
KXP3151	407

STAR MICRONICS

NP10	139
NB24-10	437
NX10	160
NX15	306

TOSHIBA - Call on all models

RAM

64K 150NS (set of 9)	16.50
256K 150NS (set of 9)	33
256K 120NS (set of 9)	Call

TERMS: Shipping on most software is $5.00. AZ orders +6.7% sales tax. Personal check/company check - allow fourteen (14) days to clear. We accept purchase orders from authorized institutions for 3.5% more than cash price. All returns are subject to our approval. There will be a 20% restock fee. Minimum phone order $50. All prices are subject to change. Due to copyright laws we cannot take back any open software.

No Charge for Master Card or Visa

MasterCard VISA

We do not guarantee compatibility

TOLL-FREE ORDER LINE 1-800-421-3135

WAREHOUSE DATA PRODUCTS

2701 West Glendale Ave. • Phoenix, AZ 85051

Phone Hours: Monday, Wednesday & Thursday 7 am-9 pm; Tuesday & Friday 7 am-5 pm; Saturday 9 am-5 pm. MST.

use predefined algorithms are insufficient in situations that do not have accurately known structures or have changed due to system malfunctioning. Predefined adaptive algorithms do exist, but they use iterative least-squares approximations to deal with the problem of changing situations.

These algorithms are too computationally intensive for use in real-time applications, since such schemes require cumbersome lookup tables and prior knowledge. Furthermore, neural networks are intrinsically fault-tolerant, letting neural circuits survive orders of magnitude longer than present-day circuitry. In fact, neural-circuit technology should be able to make up for propagation delays, jitter, and noise, making systems virtually fail-safe.

The self-organization property offers a method of dealing with unexpected situations that cannot be described mathematically. An example is the management of real-time databases encountered in knowledge-based applications for complex industrial-control strategies, such as making decoding decisions based on the present status of the system.

In the context of neural-based robotic-control strategy, self-organization will enable control with inaccurately known mechanical structures, or even if the mechanical structure has changed from mechanical deformation from bending, sliding, or recoil.

Furthermore, if a neuron's excitation represents the rate of contraction of particular "muscle groups," then given the coordinates of a previously unseen position in space, the neurons' excitations—their rate of contraction—determine where in space the arm will end up. With this type of self-organization, numerical stability is guaranteed.

The optimization property offers a method of finding solutions to problems that are computationally explosive. Indeed, neural networks allow for a method of dealing with the "combinatorial explosion" encountered in path minimization. For instance, researchers have shown that the optimization property can be used to perform a number of difficult tasks in computer vision, such as computing motion and brightness perception, surface interpolation, and localizing edges. Implementation of these properties will become very important for real-time vision systems that will be used in a variety of applications, such as adaptive flight-control systems.

Combinations of neural-network properties will become even more powerful. For example, a combination of self-organization and optimization will be useful for robotic-control path minimization and collision avoidance, and it will be the next step for the simplest of real-life applications. This combination will make robot motion graceful.

Although we have a long way to go to understand how the human brain actually works, it is clear that this line of research will ultimately increase our understanding of fundamental functions of human intelligence and perhaps lead to the first truly intelligent machines. ■

REFERENCES

1. Kolmogorov, A. N. "Dolk.Akad.-Nauk." AMS Translation 2,55, 1957.
2. Josin G. M. "Neural Systems for Uses as a Research Tool." *Computer Simulation in Brain Science*. Ed. E. Cotteril. Cambridge: Cambridge University Press, 1986.
3. Hopfield, J. J., and D. W. Tank. "Neural Computation of Decisions in Optimization Problems." *Biological Cybernetics*, vol. 52, 1985, pages 147–152.
4. Kohonen, T. *Self-organization and Associative Memory*. Berlin: Springer Verlag, 1984.
5. Hebb, J. O. *The Organization of Behavior*. New York: John Wiley and Sons, 1949.

ARC American Research Corporation

TURBO 12 AT

TURBO-12, 12.5 MHz, MIP meter, 80286, 1024K, 1.2mb floppy, 40mb (23ms) hard disk, parallel, enhanced kbd, mono graphics, MS-DOS 3.2, ARC monitor, 24 month warranty

$2,895.00

60mb (23ms) $3,295.00

SCSI ARC 386

ARC 386, 16 MHz, 80386, 640K, 1.2mb floppy, 40mb (SCSI interface) hard disk, clock, parallel, enhanced kbd, DOS 3.2, ARC monitor, 24 month warranty

$3,895.00

70mb SCSI $4,395.00

TURBO 10 XT

TURBO-10, 10 MHz, XT, 640K, 360K floppy, 20mb hard disk, game, serial, parallel, clock, AT kbd, mono graphics, MS-DOS 3.2, ARC monitor, 24 month warranty

$1,595.00

40mb $1,795.00

Zenith data systems

All Zenith Computers include 640K, serial, parallel, MS-DOS 3.2, monochrome, kbd

PC-159 (4.77/8 MHz)

2 f/d		$1,483
1 f/d	20mb	$1,699
2 f/d	ega	$1,760
1 f/d	20mb ega	$1,976

PC-248 (8 MHz 0 Wait)

1 f/d	20mb ega	$3,095
1 f/d	40mb ega	$3,675

PC-386 (16 MHz)

1 f/d	40mb ega	$5,135
1 f/d	80mb ega	$5,921

EZ-PC (7.16 MHz)

2 f/d	3½"	$899
1 f/d	3½" 20mb	$1,199

PC-181/183 (Laptops)

2 f/d	3½"	$1,699
1 f/d	3½" 10mb	$2,499

MONITORS

ZVM-1220/1230	$109
ZVM-1240	$156
ZVM-1330	$489
ZVM-1380	$629
ZVM-1470	$252
Flat Tension	$CALL

OTHER STUFF

Seagate	225 kit	$299
	238 kit	$349
	251	$459
	4038	$525
	4096	$959
Priam	ID40	$679
	ID60	$879
	ID130	$2,199
NEC Multisync		$539
GB-1		$349
EVA 480 (same as GB-1)		$299

PRINTERS

ALPS	2000	$726
	2100	$1,157
	218	$439
	224	$512
	318	$655
	324	$727
NEC	P6	$469
	P7	$633
	P9	$1,098
	CP6	$548
	CP7	$727

EPSON, TOSHIBA, S/REED, CITIZEN, STAR $ CALL

We have many other products please call for prices

WYSE

All WYSE Computers include 640K (min.), serial, parallel, enh kb MS-DOS 3.2, mono grphcs, WYSE 530 monitor

PC-2108 (8 MHz AT)

1 f/d	20mb	$1,899
1 f/d	40mb	$2,159

PC-2200 (10 MHz AT)

1 f/d	20mb	$2,119
1 f/d	40mb	$2,519
1 f/d	130mb	$4,199

PC-2112 (12 MHz AT)

1 f/d	40mb	$2,989
1 f/d	60mb	$3,219

PC-2214 (12 MHz 0 Wait)

1 f/d	40mb	$3,285
1 f/d	130mb	$4,866

PC-3216 (386 16 MHz)

1 f/d	40mb	$3,999
1 f/d	70mb	$4,349
1 f/d	130mb	$5,599

MONITORS

WYSE 530	$175
WYSE 630	$449
WYSE 640	$549
WYSE 700	$759

TOTAL SOLUTIONS CONSULTANTS
9554 Old Keene Mill Rd. Burke, VA 22015
(703) 440-9444

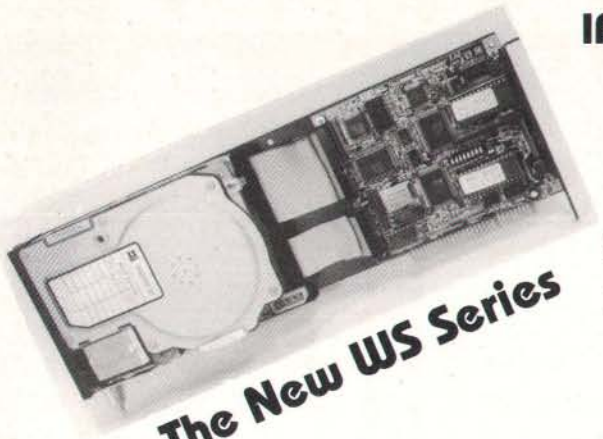
VISA M/C CHOICE
C. O. D.

HOURS: M-F 10-6
SAT 10-4

Circle 457 on Reader Service Card

THE PERIPHERAL

MONTHLY SPECIAL

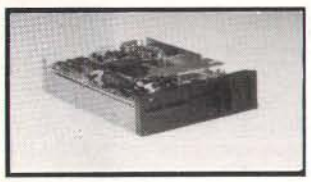


IBM PC / XT / AT & Compatibles HARD CARDS

	XT	AT
10 Meg.	289 ea	369 ea
20 Meg.	499 ea	599 ea
30 Meg.	729 ea	849 ea

Cards Can Support Additional Hard Drives, Up to 40 megs.

MONTHLY SPECIAL



Floppy Drive Half High

3 1/2" ..... $149 ea
1 Meg. For XT only
Must Use DOS 3.2

40 Track ..... $79 ea

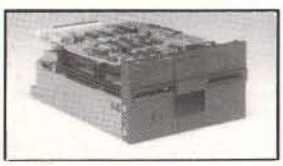
80 Track ..... $89 ea
For IBM-XT

1.2 Meg. ..... $119 ea
For IBM-AT

Floppy Drive Full High

80 Track ..... $69 ea
96 TPI

Double your Disk Drive Capacity



720K Formatted
DS/DD 80 Track
Compatible with all IBM software PC DOS (3.1)
Allows you to read IBM Formatt Diskettes
Requires (1) 40 Track DS/DD Drive
Package Includes: 1 SA460 DS/DD 96TPI Drive, Device Driver and Installation Instructions.

½ High Version/$99
Includes Software

$79 ea Includes Software

Device Driver Sold Separately for $30

Internal Tape Backup Systems

TALLGRASS TECHNOLOGIES
COMMITTED TO MEMORY

IBM PC/XT/AT

* COMPAQ DESKPRO
* COMPAQ DESKPRO 286
* AT&T 6300 PC

20 MEG*	40 MEG*
359 ea	569 ea

Operates with all 4.77, 6, 8, 10, and 12 MHz systems. Comes complete with Controller Card, Cable, Users Manual, File by File, and Image Software.

(External Tape Backup Systems Also Available)

SALE GOES ON

Hard Drive Specials

5 Meg ..... $99 ea
Full High (85 MS)

10 Meg ..... $139 ea
Full High (72 MS)
Formats to 10 Meg.

10 Meg ..... $149 ea
1/2 High (80 MS)
Formats to 10 Meg.

15 Meg ..... $189 ea
Full High (80 MS)
Formats to 15.8 Meg.

20 Meg ..... $235 ea
1/2 High (80 MS)
Formats to 20.8 Meg.

20 Meg ..... $279 ea
Full High (38 MS)
Formats to 20.8 Meg.

30 Meg ..... $349 ea
Full High (38 MS)
Formats to 31.5 Meg.

40 Meg ..... $479 ea
Full High (29 MS)
Formats to 39.9

72 Meg ..... $799 ea
Full High (28 MS)

85 Meg. Hard Drive

72 Meg. Formatted, 28 MS Access Time

Model # CDC 94155-86
Factory New

~~List Price $1195 ea~~

Our Price $799 ea

NCL 5127 Winchester Disk Controller For the IBM PC/XT and Compatibles

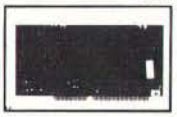
$93 ea

The NCL 5127 allows the user various options and applications from desk tops to portables. It's compact size is achieved through CMOS surface mount technology without sacrificing performance or quality.

*Add $6 for Set of Cables

- ST 506/412 Interface
- Drive Power Connector
- Switch Selectable Drive Types
- 625Kbyte Data Rate
- Operates With PC-DOS and MS-DOS
- Compact Size (3.9"x4.7")
- Automatic Surface Scan During Format
- Partition Option for High Capacity Drives
- Supports up to 16 Heads and 1024 Cylinders
- Programmable Interleave

NCL 5125 Winchester/Floppy Disk Controller For the IBM AT and Compatibles



$179 ea

- The NCL 5125 is a compact Winchester/Floppy combination controller retaining the "AT" height utilizing surface mount technology.

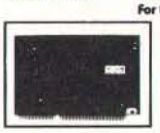
- Compact Size (3.9"x8")
- ST 506/412 Interface
- Controls Up to 2 Winchesters
- Supports Concurrent
- 32 Bit ECC
- Supports 1.2 Mbyte and 360 Floppy Drives
- 2 Mbyte Data Transfer
- Supports up to 16 Heads and 9048 Cylinders
- Overlapped Seeks

3 1/2" Floppy Drive & Case

3 1/2" 1 Meg. Floppy formats to 720k. Comes complete with 5 1/4" case that fits into any XT or Compatible. Includes both cables, hardware and instructions. (For XT Only. Must use DOS 3.2)

$169 ea

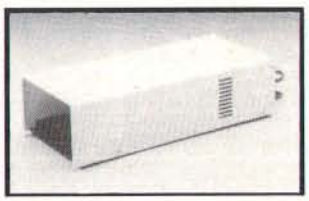
NCL 5126 Winchester Disk Controller For the IBM AT and Compatibles

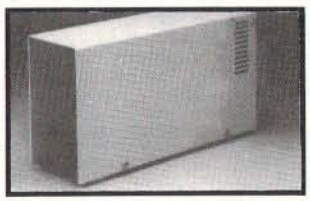


$159 ea

The NCL 5126 is designed exclusively for Winchester only allowing the floppy chip to reside on the main CPU board.

- Compact Size (3.9"x6")
- 2 Mbyte Data Transfer
- Controls Up to 2 Winchesters
- Supports Concurrent Data Operations
- 32 Bit ECC
- ST 506/412 Interface
- 16 Bit Data Transfer
- Supports up to 16 Heads and 2048 Cylinders
- Programmable Disk Parameters
- Overlapped Seeks





External Floppy Disk Drive Case with Power Supply

HD-1-38 ... **$89 ea**
Case for (1) 1/2 High Low Power Hard Drive with 38 Watt Power Supply Horizontal or Vertical

HD-2-76 .... **$149 ea**
Case for (2) Low Power Hard Drives or (1) High Power Hard Drive with 76 Watt Power Supply and Fan Horizontal Only

FD-2-38 .... **$89 ea**
Case for (2) 1/2 High Floppy Drives With 38 Watt Power Supply Vertical Only

All units come with 6 ft power cord
Add $7 to cover shipping on each case
Cables for Case for IMB/PC/XT and Compatibles .... $27 ea

Prices & Specifications Subject To Change
Products Subject To Availability

TO ORDER:
Please send cashier's or certified checks ONLY
Add $4 shipping per item
Master and Visa accepted
CA residents add 6% sales tax
Canadian residents add $10 shipping
Exchanges only/no cash refunds
Software is non-refundable
Credit Card Purchases Add 3%
IBM PC/XT/AT IS TRADEMARK OF IBM

To Place Order: (Outside Calif.) Call Toll-Free **1-800-533-3326**
(Inside Calif.) Call **714-538-4323**
For Technical Support: Call **714-538-4326**

western systems

950 N. Elm St., Orange, CA 92667

Circle 458 on Reader Service Card

COMMIX 32: A complete table-top network for PCs and minicomputer hosts. Optional Ethernet and Wide-area link modules, Print Buffer module, and MS-DOS® Network Utilities. Powerful Solutions for Small and Large Networks!

PC Networks: Do you need a PC LAN and multi-user file server, or just advanced communications?

Chances are your company's operations are managed on a mini or mainframe host; PCs are for personal productivity (word processing, spreadsheet analysis, etc.). So the interactive (operations) files reside on the multi-user host and PC users need to conveniently exchange files, share peripherals and access the host. So what do you need in a PC network? You need COMMIX 32, for ease of installation and use, you can't buy anything better! and COMMIX is priced at under $125 per port.

COMMIX Software Utilities Provide Unsurpassed Productivity

ITRON has added exceptional value to COMMIX 32 with an MS-DOS® software package that includes background file transfer, electronic mail, terminal emulation and printer sharing utilities. The COMMIX utilities are configured and controlled from pop-up menus for ease of set-up and use. The printer sharing utility, CPS, while in background mode, intercepts print requests from DOS applications, rerouting through COMMIX to the printer of your choice. Background file transfer and E-mail utilities serve local and remote users while running most popular applications programs.

Ideal PC-PC and Mini-Host Communications

COMMIX 32 uses the popular "AT" modem protocol for connection command, treating each port or port group as a telephone extension number. This means that popular software such as Crosstalk® or Mirror® can be used to make connections, transfer files, or emulate a terminal when the connection is to a minicomputer host—at up to 19.2 kbps! Wide area calls can be made through an "AT" modem connected to a COMMIX port. The connection command from the PC software appears as an access code in front of the remote telephone number. Remote modem users can call into COMMIX via an attached modem and select any PC, mini-host port, or printer. COMMIX 32 converts speed, async format and flow control set-up parameters as required for each connection. This allows maximum sharing of printers, host computer ports, and PC data for local and remote users. An optional Ethernet link module provides distributed logic switching for larger or multiple host networks. The optional Wide Area link module provides a multi-channel, high speed synchronous bridge to other COMMIX systems or networks.

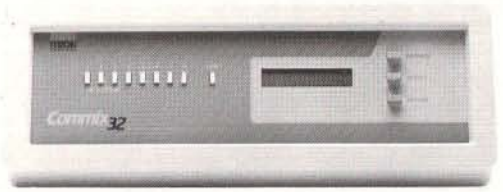
Mini Host Networks: Port contention and shared peripherals with universal connectivity.

COMMIX 32 is the ideal data switch for multi-user minicomputer hosts, such as the MicroVax®. Advanced switching features allow universal port contention or utilization with convenient printer sharing and modem pooling. COMMIX 32 provides an alternate "native" connection protocol that is convenient for terminal users. Port class and auto-queue features for port/peripheral contention provide additional functionality. An optional one megabyte print spooler module, managing two printers, frees your computer from print job delays. Other features, such as built-in diagnostics with fault reporting and console control of the network with statistical reporting, make COMMIX 32 your best PC network solution.

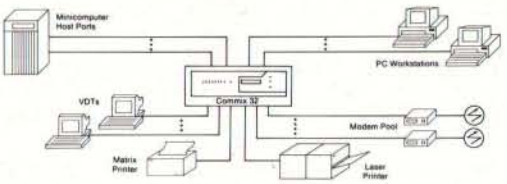
Call our toll free number for complete information today!

P.S. Yes, we do have a nationwide field service organization!

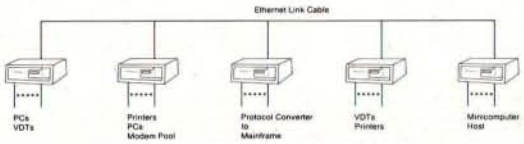
COMMIX 32—Under $125 per Port



Universal Connectivity



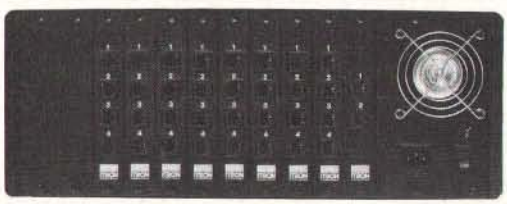
Standard or Thin Ethernet Links



Data Switching Features

- Up to 32 async ports
- *Expandable user I/O in 4-port module increments*
- *Port rates (ABR and preset) to 19.2 kbps*
- *Speed and async format conversion*
- *Flow control, selectable as in-band or EIA signal type*
- *EIA control signal handshaking*
- *Local echo, selectable at any port*
- *Stored virtual circuits, and virtual call connections*
- *Camp-on queue for port contention*
- *Port class feature, allowing user to define one address for any of a group of ports*
- *Inactivity timeout, user selectable and programmable from 10 to 60 minutes*
- *Call/connection status screen*
- *Password security facilities, two levels*
- *Diagnostic facilities for port and link loopbacks, and test pattern generation to verify interfaces*
- *Optional synchronous channel module*
- *I/O interface compatible with popular modular wiring system for neat, versatile and highly functional premise wiring*

Easy Installation—No Bulky Cables



ITRON
An Infotron Division

130 Gaither Drive
Suite 116
Mount Laurel, NJ 08054

(800) 423-8044
(609) 722-5575

MS-DOS, Crosstalk, Mirror and MicroVax are registered trademarks of Microsoft, Inc., Ditial Communications Associates, Inc., Softklone Distribution Corporation, and Digital Equipment Corporation, respectively.

SAVE 15%

on these new computer books and software from McGraw-Hill

CALL TOLL-FREE 1-800-2- MCGRAW

INTRODUCING PC-DOS AND MS-DOS

By T. Sheldon. *374 pp., illus., softbound* Find out about the free advanced capabilities of DOS and how to use them. "Wonderfully enlightening . . . well-written . . . my pick for technical book of the year."—*Online Review* 056559-7. Regular Price: $18.95. **Your Price: $16.10.**

INTRODUCING UNIX™ SYSTEM V

By R. Morgan & H. McGilton. *480 pp., illus., softbound* Guides you step by step through the facilities, commands, utilities, and applications of System V, AT&T's new version of the UNIX operating system. 043152-3. Regular Price: $19.95. **Your Price: $16.95.**

UNIX™ UTILITIES: A Programmer's Guide

By R. S. Tare. *640 pp., illus., softbound* Save time and effort with popular UNIX utilities! Helps you write efficient, bug-free programs *and* significantly reduce turnaround time. 062884-X. Regular Price: $24.95. **Your Price: $21.20.**

HOW TO BE A SUCCESSFUL COMPUTER CONSULTANT

By A. R. Simon. *256 pp., illus., softbound* Everything you have to know to set up and run your own computer consultant (or software development) business, full- or part-time. No business experience required! 057296-8. Regular Price: $18.50. **Your Price: $15.70.**

dBASE DEMYSTIFIED: dBase II/III/III Plus™ Applications and Solutions to Real Problems

By L. Barnes. *288 pp., 120 illus., softbound* Covers the full range of dBase features and shows how to apply the various releases of dBase to real-world problems. 003844-9. Regular Price: $19.95. **Your Price: $16.95.**

BUILDING YOUR FIRST EXPERT SYSTEM

By T. Nagy, D. Gault, & M. Nagy. *293 pp., book/disk (IBM PC and compatibles)* How to easily create your own working expert system. A book/disk combination ideal for beginning programmers. 912673-1. Regular Price: $19.95. **Your Price: $16.95.**

GETTING THE MOST OUT OF YOUR EPSON PRINTER

By D. A. Kater & R. L. Kater. *224 pp., 170 illus., softbound* The A to Z of the popular Epson printer and how to make maximum use of it. Covers the full line. 033385-8. Regular Price: $19.95. **Your Price: $16.95.**

dBASE III PLUS™ TRAIL GUIDE

By H. Dickler. *350 pp., book/disk (IBM PC and compatibles)* Follow this step-by-step trail and learn dBase III Plus in one week! With valuable programs you can modify and use over and over again. 912709-6. Regular Price: $29.95. **Your Price: $25.45.**

A COMPREHENSIVE GUIDE TO AI AND EXPERT SYSTEMS

By R. I. Levine, D. E. Drang, & B. Edelson. *256 pp., 99 illus., softbound* All about artificial intelligence and how to utilize it on your personal computer. Gives you everything from basic concepts to sophisticated programming techniques. 037470-8. Regular Price: $19.95. **Your Price: $16.95.**

MICRO-EXPERT

By B. Thompson & W. Thompson. *74 pp., book/disk* Become an instant expert with the world's most widely used expert system shell. Includes its own source code so you can tailor it to meet your needs. "Highly recommended."—*Online Today* IBM PC (and compatibles): 852109-2. Apple II (all models): 852110-6. Apple Macintosh: 852138-6. Regular Price (all versions): $49.95. **Your Price: $42.45.**

For fast service call TOLL-FREE 1-800-2-MCGRAW or use coupon below. 15-day examination period.

McGraw-Hill Book Company
P.O. Box 400, Hightstown, NJ 08520

Please send me—at 15% off the regular price—the products whose code numbers (the number before the regular price in above blurb) I have checked below. I understand I have 15 days for free examination before I send payment for those products I want to keep (plus postage, handling, and local tax) and return any unwanted products postpaid.

☐ 056559-7 $16.10	☐ 003844-9 $16.95	☐ 037470-8 $16.95
☐ 043152-3 $16.95	☐ 912673-1 $16.95	☐ 852109-2 $42.45
☐ 062884-X $21.20	☐ 033385-8 $16.95	☐ 852110-6 $42.45
☐ 057296-8 $15.70	☐ 912709-6 $25.45	☐ 852138-6 $42.45

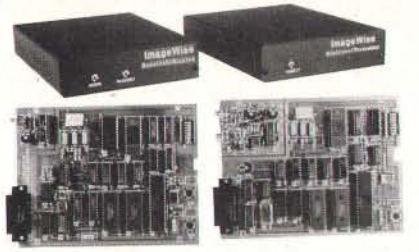
Name _____

Address _____

City _____ State _____ Zip _____

MICROMINT'S Gold Standard in Single Board Computers & Controllers

Announcing DT01/DR01
Serial Digital Imaging System



MICROMINT INTRODUCES A STAND-ALONE SERIAL DIGITAL IMAGING SYSTEM. The MICROMINT **ImageWise™ Serial Digital Imaging System** is the most cost effective and versatile high performance grayscale video digitizing system on the market today. The ImageWise system has been designed to function as a standalone digitizer or as an integral component of a complete tele-imaging system. **ImageWise™**'s serially bit mapped digitized pictures give it almost universal compatibility with any computer capable of attaching to a modem or terminal. It is ideally suited for CAD/CAM, Desktop Publishing, automatic inspection, and security applications.
Critical-System functions such as image resolution and picture update can be controlled and commanded remotely. Images are transmitted and received serially, either compressed or uncompressed, and can be displayed, transmitted, stored, edited, or processed for use in a variety of industry standard application software.

IMAGEWISE SYSTEM SPECIFICATIONS

- NOT bus dependent — can function standalone
- True frame grabber — uses a high speed flash A/D converter and 64K bytes of static RAM to capture an image in 1/60th second.
- Accepts any B/W or color NTSC video signal.
- Stores pictures as 244 lines of 256 pixels, 64 levels grayscale.
- Resolution of transmitted image is software selectable. all images are represented in 64 levels of gray scale.
  Selectable Resolutions:
  High: 256x244x6
  Med: 128x122x6
  Low: 64x61x6
- Video Input: 1 volt peak-to-peak, B&W or color 75 ohm termination
- Video Output: 75 Ohm, 1.5 V peak-to-peak NTSC composite video
- Serial Input/Output: RS-232 — 8 bit, one stop bit, no parity 300 bps — 57.6Kbps selectable data rate — Xon / Xoff Handshaking Switch selectable data compression (on/off)
- Modem compatible: Easily functions as a video telephone to send video images anywhere.
- Video processing, disk upload/download, and display utilities provided for PC-DOS and MS-DOS machines

Optional PC Utilities Disk converts ImageWise™ files for use with popular Desktop and Paint Programs.

DT01	ImageWise Digitizer / Transmitter	**$349.00**
DR01	ImageWise Receiver / Display	**$349.00**

Announcing OEM-286 — $775.00
complete PC/AT-CPU

Low Power!

Expansion Card Form Factor!

100% AT Compatible!

MICROMINT's **OEM-286** is a complete PC/AT-CPU and more. The **OEM-286** is the first low power, 100% AT compatible which has been specifically designed for OEM use within the industrial and business sectors. The **OEM-286** features the Zymos CMOS POACH set and 100% compatible Award BIOS. The development of the POACH chip set has allowed the 199 IC's on a standard AT to be reduced to 90 IC's and two SIMMS. What this means for you is:

1) The overall size of a standard AT/CPU has been condensed into the expansion card form factor. (13¼" x 5⅞")
2) Power requirements are less then 1 A @ 5 volts.
3) **OEM-286** plugs into a passive backplane for easy connection to other expansion peripherals.

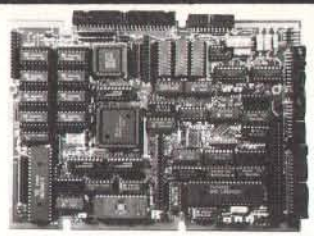
The **OEM-286** is available in both 8 and 10 Mhz versions and comes with the Award BIOS

OEM-286 FEATURES

- 100% AT compatible
- 80286 Microprocessor, 8 or 10 Mhz
- 80287 Co-Processor optional
- 64 Kbytes of ROM, can accommodate 128 Kbytes
- 512 Kbytes of RAM
- Keyboard Controller
- Expansion card size factor
- Standard interface to the System Expansion Bus
- Battery backed real time clock.
- Award BIOS included.

OEM-286/8	8 MHz AT/CPU	**$775.00**
OEM-286/10	10 MHz AT/CPU	**$825.00**
OEM-286/BP	8 SLOT PASSIVE BACKPLANE	**$115.00**

SB180FX — $409.00
Single Board Computer



SB180FX TECHNICAL SPECIFICATIONS

PROCESSOR
- Hitachi HD64180, an 8-bit CPU in a 68 pin PLCC package
- Superset of Z-80 instruction set, including hardware multiply
- Integrated Memory Management Unit with 512K bytes address space
- Dynamic RAM refresh
- Wait state generator
- Clocked serial I/O port
- 2 channel Direct Memory Access Controller
- 2 channel Asynchronous Serial Communication Interface
- 2 channel 16-bit Programmable Reload Timer
- 12 interrupts
- Dual bus interface to 68xx and 80xx support chips
- 6.144MHz, 9.216MHz, and 12.288 MHz system operation

MEMORY
- 512K bytes dynamic RAM on board
- Memory externally expandable to 4 Mbyte RAM
- Either an 8K 2764, 16K 27128, or 32K 27256 EPROM usable
- Full function 8K ROM resident monitor

INPUT/OUTPUT
- Console RS-232 serial port with auto-baud rate select to 38,400 baud
- Peripheral RS-232 serial port, full handshaking, 150-38,400 baud
- Line printer parallel I/O port
- 24 bits bi-directional parallel I/O
- 19-bit address decoding. I/O port decoding, and dual bus interface brought out to expansion bus connector
- Can be directly attached to GT180 640 x 480 color graphics adapter
- Fully implemented SCSI hard disk and communications bus interface

FLOPPY/HARD DISK INTERFACE
- Uses Standard Microsystems 9266 disk controller
- Compatible with NEC 765A controller
- On-chip digital data separator
- Can control 3½", 5¼", and 8" floppy disk drives — up to 4 in any combination
- Handles both FM encoded (single density) and MFM encoded (double density) data
- NCR 53C80 SCSI bus controller for hard disk or network communication

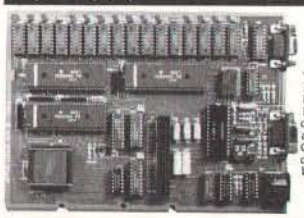
SOFTWARE COMPATIBILITY
- CP/M, ZRDOS, ZCPR3 Compatible

SB180FX-1	SB180FX - 6.144 MHz computer board populated w/ 256K bytes RAM, 8K byte ROM monitor, without SCSI chip. Add $50.00 for 9 MHz.	**$409.00**
SB180FX-1-30	SB180FX-1 computer board as described above with Z-System software including ZRDOS, ZCPR3, editor, utilities, ZAS assembler, and ZDM debugger. BIOS and ROM monitor sources, and BIOS for SCSI hard disk. Supplied on five 5¼" SB180 format DSDD disks.	**$499.00**

SB180 — $299.00
Single Board Computer

SB180-1	SB180 - 6.144 MHz single board computer w/256K bytes RAM and ROM monitor. Add $50.00 for 9 MHz	**$299.00**
SB180-1-20	Same as above w/ZCPR3, ZRDOS, BIOS and ROM sources	**$399.00**
COMM180-S	SCSI Hard Disk Interface	**$150.00**
SB180-1	**OEM 100 QUANTITY PRICE**	**$195.00**

GT180 — $395.00
Graphics Display System



The **GT180** has both TTL RGB (red-green-blue intensity) and analog RGB outputs, is totally compatible with virtually all standard and multiscan CRT monitors, and has a connector for an IBM PC keyboard.

The **GT180** offers these features:
- Advanced graphics controller provides intelligent link between computer and user
- Only 5.75" x 8", piggy-backs on either an SB180 or SB180FX computer
- High resolution at a low cost: 640 x 480 with 16 of 4096 colors
- Hardware drawing commands: LINE, RECTANGLE, POLYLINE, POLYGON, CIRCLE, ELLIPSE, ARC, FILLED RECTANGLE, PAINT, PATTERN, WINDOW, and COPY to name but a few
- Automatic translation of logical X-Y coordinates to physical frame buffer addresses
- Fast drawing speed of 2 million pixels per second
- Provides fully programmable horizontal split screens and window screen
- Fully supported by **GT180** Graphix Toolbox written in Modula-2

GT180-1	Graphic Display Expansion Board (TTL RGB only)	**$395.00**
GT180-2	Graphic Display Expansion Board (TTL RGB and Analog RGB)	**$449.00**

SB180
Software and Accessories

SB180-U	Uniform Disk Format Conversion Software	**$ 69.95**
SB180-ZMSG/TKBBS	Z-MSG Bulletin Board Software	**$100.00**
SB180-MOD2	Turbo Modula 2	**$ 69.00**
SB180-MOD2G	Turbo Modula 2 w/Graphix Toolbox	**$ 89.00**
SB180-CASE	Four half height 5¼" drive enclosure w/power supply, mounting brackets and hardware for the SB180 or SB180FX	**$197.00**
SB180-CABLE	Set of 4 cables including power, term. disk and print	**$ 79.00**

BCC22 — $249.00
Term-Mite Smart Terminal

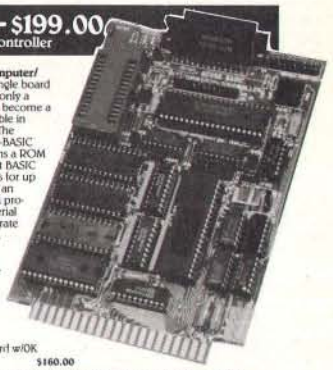
Why pay $500 or more for a smart terminal? The **TERM-MITE ST** offers you all of the following on a single board for less than ⅓ the price.

- Dimensions: 4" x 6⅛"
- 128 displayable characters
- 24 lines x 80 characters
- Separate transmit & receiver baud rates(110-19,200bps)
- CRT refresh at 50 - 60 Hz
- Supports scanned and encoded keyboards
- 11 Graphic characters
- 25th line reverse video status display
- 21 escape functions
- 14 control functions
- Directly drives composite video or separated sync monitor
- All functions are firmware controlled. Source code available

EDITING FEATURES: typeover,clear to screen to space or null, erase to end of page, erase to end of line, absolute cursor addressing.
VIDEO ATTRIBUTES: reverse video, half intensity, double height, double width, underlined, blinking and blank characters.
BUS CONFIGURATION: MICROMINT BCC compatible or no bus connection neccessary for stand-alone operation with parallel keyboard.

BCC22	TERM-MITE Smart Terminal Board	**$249.00**
BCC22K	PARALLEL Encoded ASCII KEYBOARD plugs directly into TERM-MITE	**$ 79.00**

BCC52 — $199.00
BASIC 52 Computer/Controller



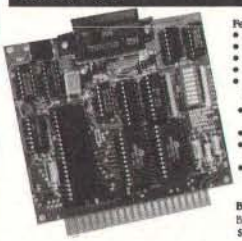
The MICROMINT **BCC52 Computer/Controller** is a stand-alone single board microcomputer which needs only a power supply and terminal to become a complete system programmable in BASIC or machine language. The **BCC52** uses the Intel 8052AH-BASIC microprocessor which contains a ROM resident 8K byte floating point BASIC interpreter. It contains sockets for up to 48K bytes of RAM/EPROM, an "intelligent" 2764/128 EPROM programmer, 3 parallel ports, a serial terminal port with auto baud rate selection, a serial printer port.

BCC52*
Basic-52 Computer/Controller
$199.00
OEM 100 QUANTITY PRICE
$149.00

BCC53
Multi Function Expansion Board w/OK adds 6 ports and 62K bytes **$160.00**

***NOW AVAILABLE IN INDUSTRIAL TEMPERATURE RANGE — CALL FOR INFORMATION**

BCC11 — $139.00
Basic Controller



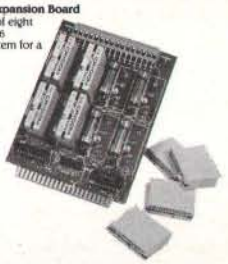
Features:
- Uses Z8 single chip microcomputer
- On board tiny basic interpreter
- 2 on board parallel ports & serial port
- 6 interrupts (4 external)
- Just connect a CRT and write control programs in Basic
- 6K Bytes of RAM or EPROM memory on board
- Baud rates 110-9600 bps
- Data and address bus available for 56K memory and I/O expansion.
- Consumes only 1.5 watts at +5, +12 & − 12V.

BCC11*
BASIC System Controller
$139.00

***NOW AVAILABLE IN INDUSTRIAL TEMPERATURE RANGE — CALL FOR INFORMATION**

BCC40 — $159.00
Power I/O Expansion Board

The MICROMINT **BCC40 POWER I/O Expansion Board** provides on/off control and monitoring of eight 115-230 VAC or 5-48VDC devices. Up to 16 POWER I/O boards may be used in a system for a total of 64 inputs and 64 outputs.



BCC40
POWER I/O Expansion Board (with no power modules) **$159.00**
with 8 Output Modules **$249.99**
with 8 Input Modules **$229.99**

BCC52 & BCC11
Software and Accessories

BCC52-ROM A	ROM A Utilities-BASIC extensions	**$ 49.95**
BCC52-ROM A/B	ROM A and B Utilities BASIC extensions and Assembler	**$100.00**
BCC52/41	ROM C Utilities-Real Time Clock and Power I/O firmware	**$ 34.00**
BCC52-OK-CLK	SMARTIME BCC52 Clock and ROM C	**$ 69.00**
BCC52-8K-CLK	SMARTIME BCC52 Clock w/8K RAM and ROM C	**$ 79.00**
BCC53	Multi Function Exp. Board w/OK — adds 6 ports and 62K Byte	**$160.00**
BCC08	Serial I/O Expansion Board	**$149.00**
BCC09	RS-232 to 20ma Converter	**$ 55.00**
BCC13	8 Bit, 8 channel A/D Board	**$129.00**
BCC30	12 Bit, 16 channel A/D Board	**$197.00**
BCC25-4	4x20 LCD Display	**$159.00**
BCC25-8	8x40 LCD Display	**$299.00**
BCC22K	Parallel Enclosed ASCII keyboard	**$ 79.00**

MOTHER BOARDS — CARD CAGES — POWER SUPPLIES

MB02	5 Slot mini-mother board (not compatible with CC01, CC02)	**$ 69.00**
MB08	8 Slot full mother board (compatible with CC01/CC02	**$ 85.00**
MB44	44 pin gold card edge connector	**$ 6.00**
CC01	10 inch Card Cage for one MB08	**$ 59.00**
CC02	19 inch Card Cage for two MB08s	**$ 79.00**
UPS11	Universal Power Supply — used for single board applications .9A @ 5V, 3A @ + 12V and .1A @ − 5V	**$ 19.00**
UPS05	Card Cage Power Supply — designed for 2 or 3 board system 1A @ 5V, 3A @ + 12V, .1A @ − 12V.	**$ 79.00**
UPS10	Heavy Duty Switching Power Supply — used for an entire BCC system 5.5A @ 5V, .7A @ + 12V, .3A @ − 12V	**$ 69.00**
UPS21	21 Volt Programming Power Supply — used for EPROM programming on the BCC52 21V + / − 2% @ 200ma	**$ 49.00**

To order call

1-800-635-3355

for technical information **1-(203)-871-6170**

TELEX: 643331

Micromint, Inc.
4 Park Street
Vernon, CT 06066

BYTE T-Shirts

Those fantastic Byte covers—and boy, do they look great on this stylish, ¾ sleeve T-shirt from Robert Tinney Graphics! The colored sleeves and neckline vividly complement the full-color design. And don't mistake this for a rubbery patch that cracks and peels off after a few washings. This is true four-color process: the permanent inks are silk-screened into the fabric, resulting in a beautiful, full-color image that lasts!

You'll also appreciate the shirt itself: a heavyweight cotton/polyester blend which combines tough washability with the cool, soft comfort of cotton. Each Byte T-shirt is priced at only $12.50 ($11.50 each for 3 or more). Be sure to include shirt size: **C**—(child 10-12), **S**—(34-36), **M**—(38-40), **L**—(42-44), and **XL**—(46-48). Most orders shipped within a week.

#T1—Computer Engineering

#T2—Software Piracy

#T3—Inside IBM

#T4—Future Past

#T5—Breakthrough

Send the following T-shirts(s) at $12.50 each, or $11.50 each for 3 or more. I have included $2 for shipping & handling ($5 overseas).

QTY.	#	TITLE	SIZE	AMOUNT
				$
				$
				$
				$
				$
				$
				$
		Shipping & handling (see above)		$
		TOTAL		$

☐ Please send your COLOR brochure

☐ I have enclosed U.S. check or money order.
☐ C.O.D. (via UPS—stateside orders only)
☐ VISA ☐ MasterCard ☐ American Express

Card #: _____

Expires: _____ Signature: _____

Ship my shirt(s) to:

Name: _____

(Business): _____

Address: _____

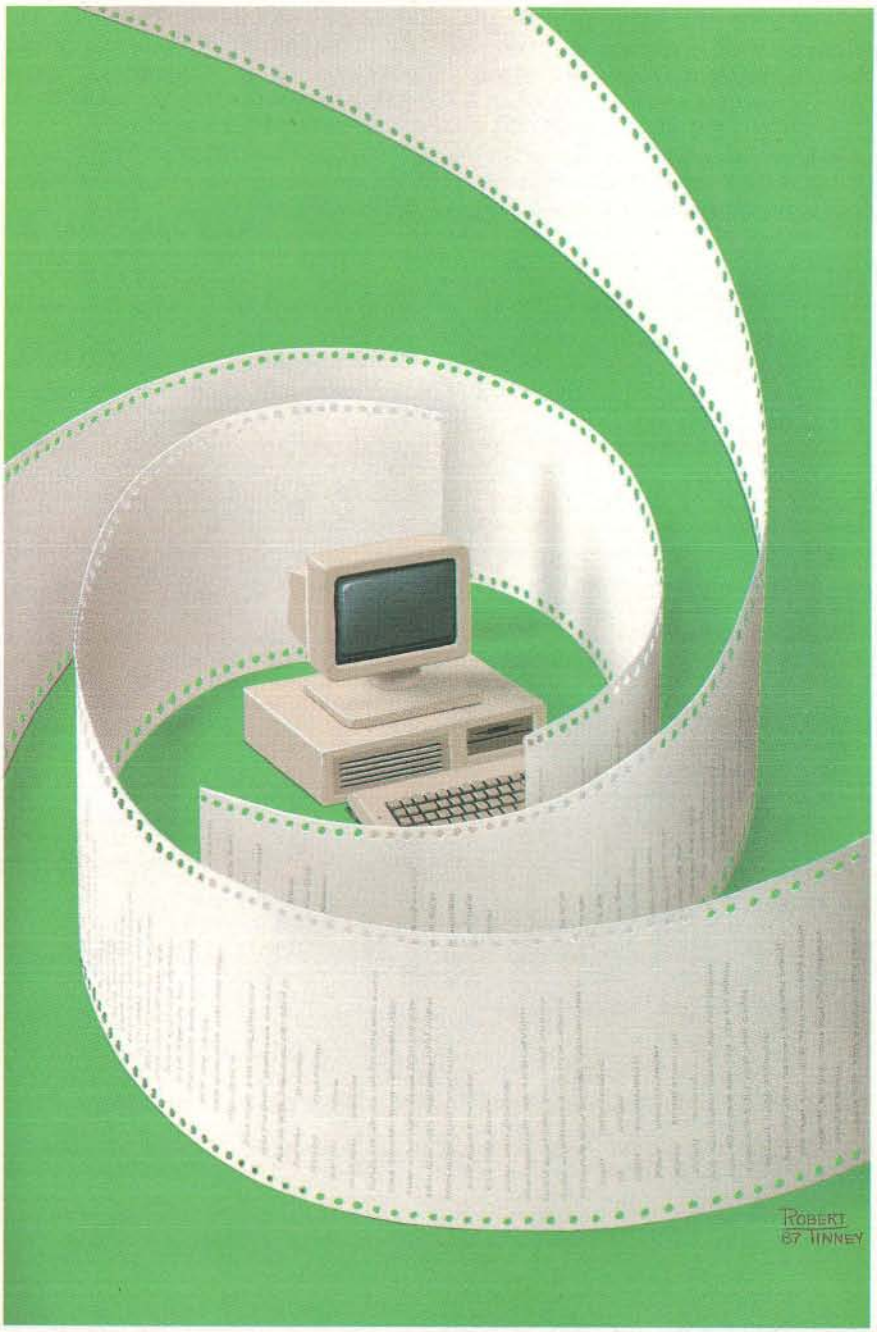
City: _____

State: _____ Zip: _____

mail this coupon to:
Robert Tinney Graphics
1864 North Pamela Dr.
Baton Rouge, Louisiana
70815

For VISA, MasterCard or American Express orders, or for more information
Call 1-504-272-7266

Reviews



REVIEWER'S NOTEBOOK

The ALR 386/2 is a second-generation 80386-based computer from Advanced Logic Research, one of the first companies to introduce an 80386 machine. The 386/2 differs considerably from the first ALR 386 in its redesigned motherboard and lower price. [Editor's note: *For a review of the ALR 386, see "The ALR Access 386 and the Compaq Deskpro 386" by Stanley J. Wszola and Curtis Franklin Jr. in the February BYTE.*]

I reviewed the ALR 386/2 Model 40, which has 2 megabytes of 80-nanosecond RAM, a 40-megabyte hard disk drive, an EGA graphics adapter and monitor, a 1.2-megabyte floppy disk drive, and serial and parallel ports. The machine has eight expansion slots (two 32-bit, four 16-bit, and two 8-bit), and uses a Phoenix BIOS. All models of the 386/2 come with a standard 101-key AT-style keyboard. The suggested retail price of the Model 40 is $3990.

The lowest priced member of the 386/2 line is the Model 10, which has 1 megabyte of RAM on the motherboard, no hard disk drive, and no graphics. The Model 10 is priced at $1990, making it one of the first 80386-based computers that costs less than $2000.

The Model 40 is available in either desk- or floor-mount configuration. The unit I reviewed was the floor mount. Some companies make a floor-mount model by slipping a stand over the case; with the ALR, the case *is* the floor stand. You can use the floor-mount model on a desk only if you position it on the far left edge of the desk, letting the stand hang over the edge.

Two major changes differentiate the 386/2's hardware from that of the original 386. Both are the result of using a new motherboard. The original ALR 386 used the Intel motherboard, which had an Intel proprietary 32-bit slot design for high-speed memory expansion. The 386/2 uses 32-bit slots that are proprietary to ALR. The most striking feature of these slots is that they are physically indistinguishable from standard AT 16-bit slots. You locate them by virtue of the *ALR special 32-bit slot* legend stenciled between them on the motherboard.

The original Intel motherboard also came with a socket for an 80387 math coprocessor. Actually, the 80387 would fit, but it wouldn't work. ALR has avoided this problem in the 386/2 by providing a socket for an 80287 (supplied on the review machine). There is a bare spot on the motherboard that is just the right size and shape for an 80387, but no socket is provided. [Editor's note: *ALR has announced that it will provide an upgrade for 386/2 owners who wish to install an 80387. The company was unable to provide cost and availability of the upgrade at press time. You can reach ALR at 10 Chrysler, Irvine, CA 92718, (714) 581-6770.*]

One of the other improvements Advanced Logic Research made for the new machine is in documentation. In the review of the original ALR 386, some of the harshest words were reserved for the manual. The user's manual for the 386/2 is a vast improvement. It is easy to read, well-organized, and has meaningful illustrations. The user's manual still would not be mistaken for a technical guide, but it is complete enough to let you get started with the computer.

The ALR 386/2 does not come with an operating system. For this review, I used PC-DOS 3.3. The 386/2 does come with software, however. ALR is now bundling a copy of Control-386, from Phoenix Technology, with the 386/2. This software brings many advantages to the machine; the most impressive is the dramatic increase in the performance of the hard disk drive. According to the Coretest software I used to measure the speed of the hard disk drive, the data transfer rate of the controller jumped from 184.2K bits per second to 434.4K bps after the installation of Control-386 version 1.1. For comparison, the Compaq Deskpro 386 has a disk transfer rate of 165.1K bps, and the IBM PS/2 Model 80 has a disk transfer rate of 456.8K bps.

Control-386 also provides disk caching, loading of ROM BIOS and EGA BIOS into 32-bit RAM, and disk interleave optimization. In addition to all these performance benefits, the software offers virtual 8086 environments, 32-bit emulation of EEMS and EMS memory, and complete emulation of the 80286. The emulation of 80286 functions includes undocumented functions, such as `LOADALL`, that are frequently used in virtual-mode software for the IBM PC AT.

The major performance boost in the 386/2 is the result of the new hard disk controller and the Control-386 software. The 100- by 25-cell spreadsheet that the original ALR 386 loaded in less than 22 seconds is loaded in less than 2 seconds by the 386/2. (For other benchmark results, see table 1.) While the boost in hard disk performance does not show up in most benchmarks, it does have a great impact on most operations that a user would perform.

In all, ALR has taken the very fast 80386 and coupled it with a very fast hard disk system. The result is a computer that should satisfy the performance needs of all but the most specialized technical applications that demand the power of workstations.

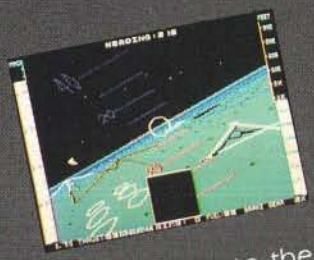
—Curtis Franklin Jr.
Associate Technical Editor

Table 1: *Benchmark results for the ALR 386/2. These C benchmark programs are described in "A Closer Look" by Richard Grehan in the September BYTE. All times are in seconds, except for the Dhrystone, which is in iterations per second. The ALR 386/2 benchmarks were run with Control-386 installed on the system.*

	ALR 386/2 10-MHz 80287	Compaq 386 8-MHz 80287	Compaq 386 16-MHz 80387	Model 80 16-MHz 80387
Dhrystone	3283	3748	3748	3626
Fibonacci	64.66	53.12	53.13	57.26
Float	5.2	6.8	1.43	1.62
Savage	17.97	21.53	8.95	9.49
Sieve	7.41	5.99	5.98	6.45
Sort	8.55	5.58	5.58	7.74

THE FLIGHT CHOICE!

From the sophisticated realism of Flight Simulator...



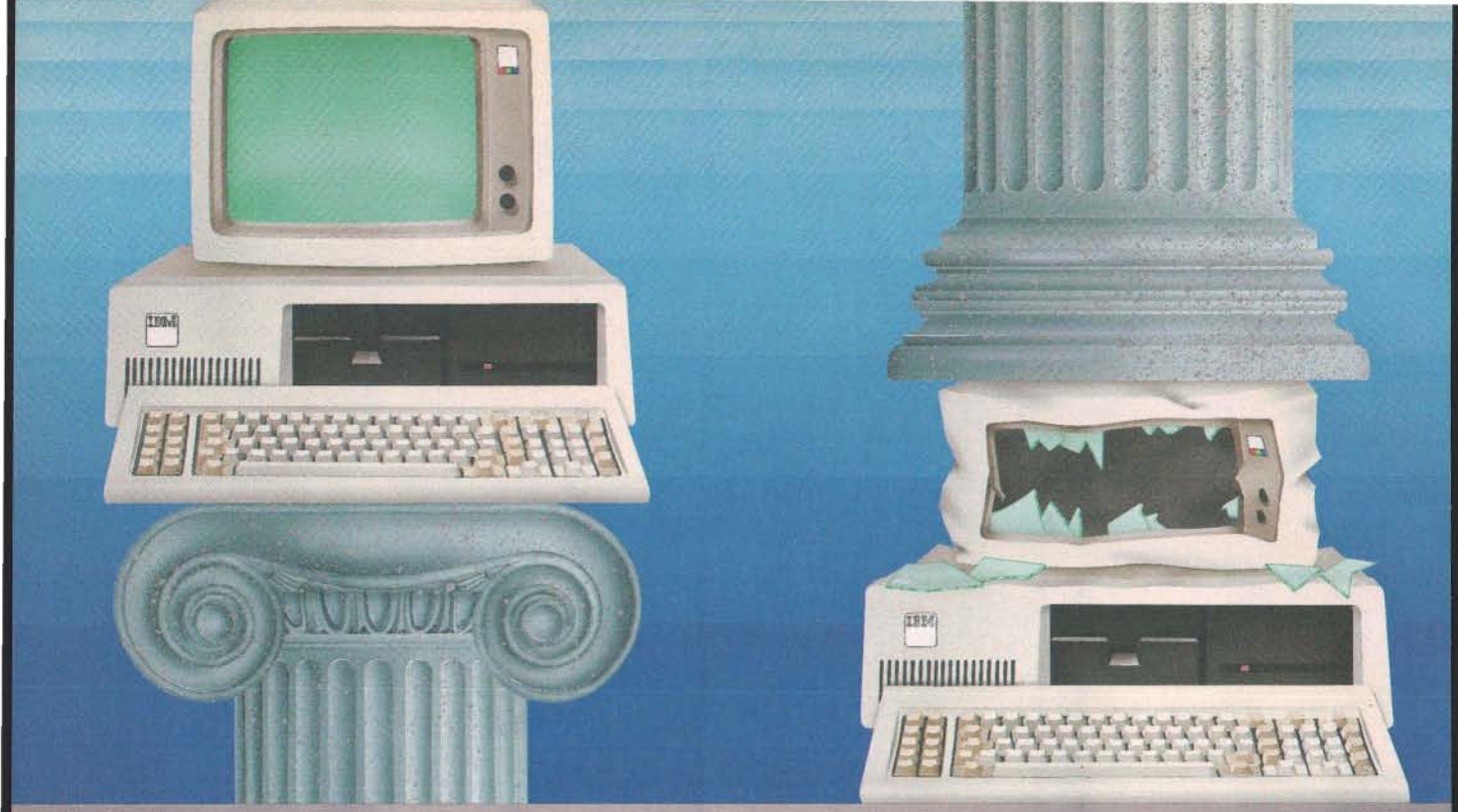
...to the thrills and excitement of Jet...

...to new Scenery Disk adventures... SubLOGIC. Make The Flight Choice.

See Your Dealer. For additional product ordering information or the name of the dealer nearest you, call (800)637-4983.

subLOGIC Corporation
713 Edgebrook Drive
Champaign IL 61820
(217) 359-8482 Telex: 206995
ORDER LINE: (800) 637-4983
(except in Illinois)

Circle 262 on Reader Service Card



QNX vs UNIX

Architecture can make or break a computer system.

If the sheer weight of UNIX brings the PC to its knees, all applications running under it will suffer. Conceived more than a decade and a half ago, UNIX is today the result of modifications, additions and patches by hundreds of programmers. It needs the resources of at least an AT.

Compare this to the QNX O/S, designed by a dedicated team with a common purpose and complete understanding of both the software and the environment in which it must run. Having elegantly solved the problem of inter-task communications, QNX is more than capable of both networking and real time performance—the superior choice for process control and office automation systems.

Quick and efficient on a PC, QNX soars on an AT. QNX occupies 80K (standalone version) to 114K (network version) of system memory and allows 40 tasks (programs) and up to 16 terminals per computer.

QNX modular architecture facilitates easy adaptation and extensions by software developers for specific requirements. In addition, PC-DOS runs as a single-tasking guest operating system under QNX. With the DOS Development System, DOS EXE files can be developed in shorter time than under DOS itself.

Communication among all tasks is via "message-passing." Tasks anywhere on a network of up to 255 computers communicate rapidly and transparently with each other.

With the true distributed processing and resource sharing of QNX, all the resources on the network are available to any user. Application programs and data can be distributed over the network without having to go through a central file server.

Network growth is fast and simple. If your disk becomes a bottleneck, add a disk anywhere on the network. If your needs outgrow your present configuration, just add terminals and/or computers as required, without having to re-write programs and without system degradation.

If you would like to know the secret of the QNX architecture, please give us a call. We invite End Users, VAR's, OEM's and Software Developers to discover a whole new world of computing capabilities.

Over 30,000 systems have been installed worldwide since 1982.

THE ONLY MULTI-USER, MULTI-TASKING, NETWORKING, REAL-TIME OPERATING SYSTEM FOR THE IBM PC, AT, THE HP VECTRA, AND COMPATIBLES.

Multi-User	10 (16) serial terminals per PC (AT).	**C Compiler**	Standard Kernighan and Ritchie.
Multi-Tasking	40 (64) tasks per PC (AT).	**Flexibility**	Single PC, networked PC's, single PC with terminals, networked PC's with terminals. No central servers. Full sharing of disks, devices and CPU's.
Networking	2.5 Megabit token ring. 255 PC's and/or AT's per network. 10,000 tasks per network. Thousands of users per network.	**PC-DOS**	PC-DOS runs as a QNX task.
Real Time	2,800 task switches/sec (AT).	**Cost**	From US $450. Runtime pricing available.
Message Passing	Fast intertask communication between tasks on any machine.		

QNX

For further information or a free demonstration diskette, please telephone (613) 591-0931.

Quantum Software Systems Ltd. • Kanata South Business Park • 175 Terrence Matthews Crescent • Kanata, Ontario, Canada • K2M 1W8

The Macintosh II

Bruce F. Webster

A powerful 68020 CPU, NuBus slots, and color, with a few compatibility problems

Back in February 1984, I bought a Macintosh computer right off the shelf. It had a 512- by 384-pixel monochrome display, 128K bytes of RAM, 64K bytes of ROM, a single 400K-byte floppy disk drive, and a 68000 CPU running at 7.83 megahertz. It had no expansion slots, no means of expanding RAM, and no external disk drives or hard disks available. It cost me around $2500, and there were only three software packages available for it: the MacPaint/MacWrite combination from Apple, Microsoft Multiplan, and Microsoft's BASIC interpreter.

Now, more than three years later, I have a Macintosh II sitting in my office. It has a 640- by 480-pixel gray-scale display, 1 megabyte of RAM, 256K bytes of ROM, an 800K-byte floppy disk drive, a 40-megabyte internal hard disk drive, an Apple video card with 256K bytes of video memory, and a monochrome monitor. It has six NuBus expansion slots. It can be expanded to many megabytes of RAM via both the motherboard and the NuBus slots, and a variety of disk drives (both internal and external) are available. This system costs around $6267, and there are hundreds of software packages available for it.

The Macintosh II System

The Macintosh II has already been covered extensively in the product preview that appeared in the April issue of BYTE. But I'll give a quick description of it here.

The Mac II is a modular computer system built around the 68020/68881 chip set from Motorola running at 16 MHz, and the Macintosh Toolbox and operating system routines from Apple. A full 32-bit data path is used for memory and bus access, as opposed to the 16-bit data path and 24-bit bus on the other Macintosh systems. The combination of doubled clock rate and doubled data path give roughly a fourfold increase in performance over the Mac Plus.

Since the computer has no standard video system, you can select the video display you want. Apple sells a Macintosh II video card with 256K bytes of RAM that supports 640- by 480-pixel resolution with four bits per pixel, giving you 16 colors (or gray shades) out of a palette of 16 million. A video card expansion kit adds 256K bytes of RAM to increase the pixel depth to 8 bits (1 byte per pixel), yielding 256 colors/shades simultaneously. Apple also sells two monitors to go with the video card: a 12-inch monochrome monitor, which can display gray scales, and a 13-inch RGB monitor.

However, you do not have to buy Apple's video card, nor one of its monitors. Several third-party manufacturers, such as E-Machines Inc. and Super-Mac Technology, have announced their own video cards and monitors for the Mac II.

Using the Mac II

Unpacking and setting up the Mac II took about 10 minutes, and I was taking my time. To turn on the machine, I reached to the back (right side) and pushed the power button. The monitor came on, the system booted up with the usual Mac display, and it was ready to go.

You go through this installation only once. From then on, switching on the Mac II is accomplished from the keyboard: You press a key labeled with a triangle (present on both the standard and extended keyboards), and the power's up.

The Macintosh II comes with version 4.1 of System (the operating system) and version 5.5 of Finder (the user interface). These versions have no major changes from previous versions, but there are a number of minor ones, particularly in Finder. The most significant is that the Control Panel desk accessory (DA) now has subpanels for each major hardware device (General, Keyboard, Monitor, Mouse, Sound, and Startup Device). Third-party hardware manufacturers can define subpanels for their products, and by dropping these files into the System Folder, you automatically install and select them as part of the Control Panel.

Using the Mac II is pretty much like using a regular Macintosh, but with two

continued

Bruce F. Webster (P.O. Box 1910, Orem, UT 84057) teaches at Brigham Young University.

Macintosh II

Company
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

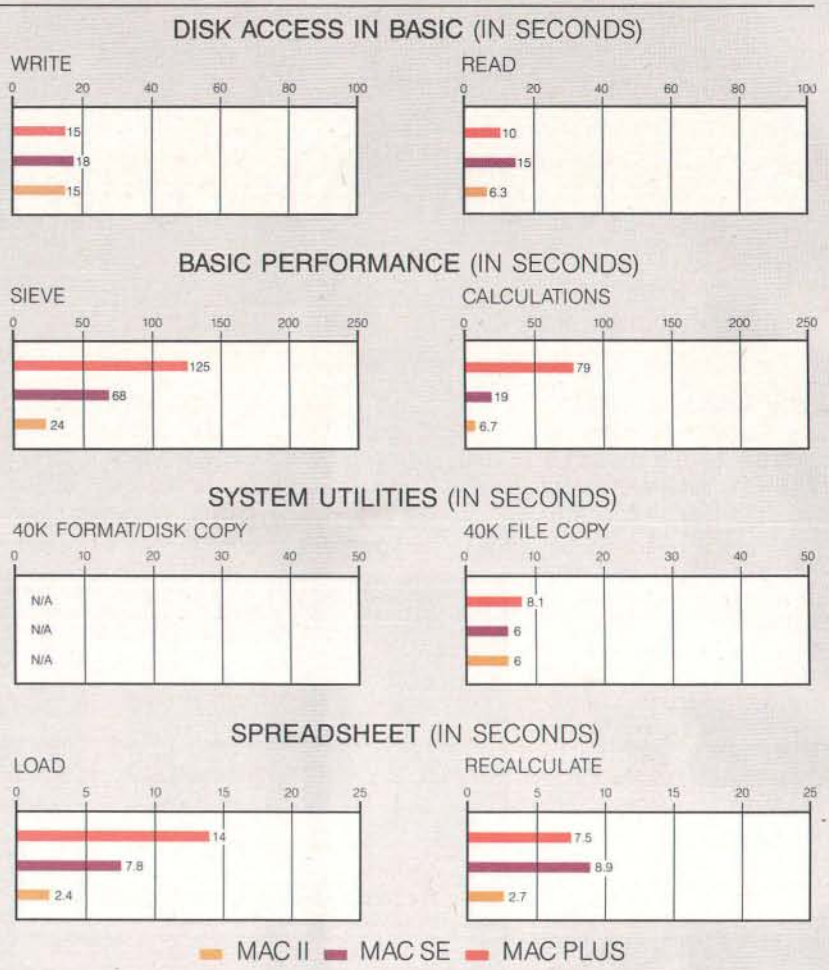
Size
18⅔ by 14⅓ by 5½ inches;
24 to 26 pounds

Components
Processors: Motorola 68020 CPU and Motorola 68881 math coprocessor running at 16 MHz
Memory: 1 megabyte of RAM, expandable on the motherboard to 8 megabytes; 256K bytes of ROM
Mass storage: Both models come with one 800K-byte 3½-inch floppy disk drive; one model comes with a 40-megabyte hard disk drive
Expansion: Six NuBus slots
I/O interfaces: Two DIN-8 serial connectors; two Apple Desktop Bus (ADB) ports; one SCSI port
Mouse: Mechanical tracking; optical shaft encoding at 90 pulses per inch; ADB connector
Sound: Apple custom digital sound chip, including 4-voice wave-table synthesis

Options:
Processors: Motorola 68851 paged memory management unit (PMMU) chip: $499
Memory: 1-megabyte RAM expansion (256K-byte chips): $349
Display: Apple video card, supports 640 by 480 display with 4 bits per pixel: $499; Apple video card expansion, expands video memory to 8 bits per pixel: $149; Apple 12-inch monochrome monitor: $399; Apple 13-inch RGB monitor: $999
Keyboard: Apple Keyboard (81 keys, including numeric keypad and cursor keys): $129; Apple Extended Keyboard (105 keys, including 15 function keys, numeric keypad, cursor keys): $229
Mass storage: Additional 800K-byte floppy disk drive: $299; 20-megabyte hard disk drive: $999;
40-megabyte hard disk drive: $1599;
80-megabyte hard disk drive: $2699

Documentation
263-page user's manual

Price
With 1 megabyte of RAM and one 800K-byte 3½-inch floppy disk drive: $3769
With 1 megabyte of RAM, one 800K-byte 3½-inch floppy disk drive, and a 40-megabyte hard disk drive: $5369



The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it takes to format and copy a 40K-byte file using the system utilities. The Spreadsheet graphs show how long it takes to load and recalculate a 25- by 25-cell spreadsheet in which each cell equals 1.001 times the cell to its left. The Mac II and Mac SE used System 4.1, Finder 5.5, and Microsoft BASIC 2.1(b) for the System benchmarks. The Mac Plus used System 3.0, Finder 5.0, and Microsoft BASIC 1.0 for the System benchmarks. Multiplan 1.02 was used on the Mac Plus and Mac II; Multiplan 1.1 was used on the Mac SE.

important differences: Everything happens much faster, and the screen is larger.

With the Mac II, the agonizing wait of the orignal Macintosh is gone: Applications and data files load very quickly, and application operations take less time. Windows jump open at amazing speeds, and file copies from the floppy disk to the internal drive were completed sooner than I expected. You can have several DAs operating simultaneously with little or no degradation of performance.

A number of the applications that I tried recognize the larger screen and automatically size their windows to match. For example, the editor window on Consulair's Edit version 2.1 fills most of the screen, allowing you to look at 123-column-wide code listings. So does Lightspeed C version 2.01, with its built-in editor. Microsoft Word 3.0 and SuperPaint also size their windows this way, giving you the ability to easily manipulate information on large documents.

Interestingly, some old programs also detect and use the extra screen space, among them Multiplan 1.02 and MacDraw 1.9 (although MacDraw's Lines menu behaves rather strangely, blanking the menu items as you use it). Unfortunately, some applications have their window dimensions hard-coded in, so that the window can't expand to make use of the extra space. This limitation is easier to tolerate if you can drag the window to another part of the screen (such as with MacWrite 4.5), but some applications don't allow you to move the small window at all (e.g., MacPaint 1.5 and Red Ryder 9.4).

The vast screen size (compared to the 9-inch monitor on the original Macintosh) also affects how you work with the Mac II. For example, the Alarm Clock DA is virtually useless on a small screen: When you summon it up, it becomes the foreground window and disables the menus in the application you're working with. Clicking on the application's window to reactivate the menus doesn't help—this hides the Alarm Clock display. But with a large screen, you summon up the Alarm Clock, drag it to an unused portion of the screen, and click back in the application window to resume work. Then you can edit, write code, or telecommunicate with an on-line service while having a running time display.

You can use a compiler to produce an application you're working on, the MockWrite DA to take notes, and the Alarm Clock DA to let you know when it's getting really late, and you don't have to shuffle through the various windows to find what you need. It's all there on the roomy screen. You find yourself arranging desk-accessory windows so that, as you use your favorite application, you can summon up additional information or handle some minor task at the click of a mouse.

To shut off the Mac II, you select the `Shut Down` command from the special menu on the desktop. This takes care of any operating system housekeeping, parks the heads on the hard disk, and actually turns the power off for you.

Color on the Mac II

One of the major features of the Mac II is its support of color. As mentioned earlier, the fully expanded Macintosh II video card supports a display with 256 simultaneous colors from a palette of 16 million (8 bits of information each for red, green, and blue). Dithering techniques can dramatically increase the number of apparent colors on the screen. This color capability is supported by Color QuickDraw, which is an extension—not a replacement—for the original QuickDraw that provides the Mac with its powerful graphics primitives. Apple also sells an RGB monitor, manufactured by Sony, which yields a clear, crisp picture.

Unfortunately, the system I reviewed came with the unexpanded video card (only 4 bits per pixel) and a monochrome monitor; Apple has a large backlog on the color monitor orders and was unable to supply one in time for this review. Selecting all 4 bits (16 shades of gray) from the control panel had a noticeable effect: The Apple logo on the menu bar developed shaded gray strips (corresponding to the color strips on the real logo).

All was not lost, though. Sony sent me one of its multiscan RGB monitors (Sony CPD-1302), along with the necessary video cable (made by Cables-To-Go). I set the switches on the back of the Sony to "analog RGB," plugged it into the Mac II, and powered up. Everything was still in black-and-white and gray, but I didn't panic; instead, I brought up the Control Panel, selected the Monitor display, and clicked on the Color button. The Mac II redrew the desktop display, and the Apple logo was in color.

That was the good news. The bad news was that I had very little software to show off the Mac II's colors. So, I figured I'd write my own program: More bad news. First, a good many of the compilers I had did not work on the Mac II, or produced code that did not work well (see the section on "Problems," on page 200). Worse yet, none of them had the interfaces and libraries needed to access the Color Manager and Color QuickDraw.

I remembered that the Mac II supported some fixed color routines in the original QuickDraw. These routines let you set the foreground and background colors out of a palette of eight colors. Using a beta version of a Pascal compiler, I whipped up a quick program to draw circles of different colors. It worked fine, and the colors did show up as expected.

Even as I write this, vendors are rushing to fill the need for color displays and support for the Mac II's Color QuickDraw. For example, Manx Software Systems has introduced version 3.4 of its Aztec C compiler; it supports the new Mac II interfaces and generates 68020 code. Think Technologies has circulated both the necessary header files and an application that patches its present C compiler (version 2.01).

Nor have users been stymied by the lack of Apple color monitors. Most on-line services now have information on how to build adapter cables to connect either the Sony or the NEC JC-1401P3A MultiSync color monitors to a Mac II.

Multiple Monitors

Even more interesting than the Mac II's support of color is its capability to have multiple monitors sharing the desktop display simultaneously. Each monitor requires a video card, which obviously limits you to six monitors (the number of slots in the Mac II). I was able to acquire a spare video card long enough to test out this capability using the Sony color monitor and the Apple monochrome monitor.

Initially, the extra monitor would display only a gray pattern at boot-up. Under the monitor section of the Control Panel, an area of dead space in the display showed something new: two gray boxes representing the two screens hooked to the Mac II. I could drag either one of the boxes to the position I wanted the extended desktop to map across the two screens: left, right, top, bottom, or even diagonally. You select which screen you want to be the master screen by dragging a tiny representation of the menu bar to the desired box.

Upon rebooting, the results are fascinating. The mouse pointer is constrained to the layout that has been set up in the Control Panel. Well-written applications let you drag windows to the extra screen. Microsoft Word 3.0 and MacDraw allow this, although you can't "grow" a window larger than the screen it occupies. The Lightspeed C editor window can actually be grown to fill both screens, although I can't imagine anyone writing code that needs that large a window. I even dragged a color window to straddle the color and monochrome monitors, and I watched the patterns change by color on one screen, and in shades of gray on the other.

continued

A logical structure called a gDevice quietly handles the updating and drawing of each screen as a window crosses the boundary of a monitor. Although you can access gDevice if necessary, for the most part you don't need to deal with it. For the programmer, if your application uses the `screenBits.bounds` global variable to set the boundaries of its window, it should work flawlessly in this type of environment without any additional code. For the typical user, the important thing to know is that the Mac II comes out of the box with this type of video support built-in.

Performance

I ran BYTE's standard C benchmarks on both the Mac II and the Mac Plus. All six tests were first compiled on the Mac Plus using Lightspeed C version 2.01. The resulting object code was run on both the Mac Plus and the Mac II. The tests were then recompiled and rerun on the Mac II, using Consulair's 68020/68881 Mac C compiler version 5.04. The results are in table 1.

First, let's look at the Lightspeed C versions. Ignoring the two floating-point benchmarks (Float and Savage), there's an average performance increase of 4.25—that is, the same code ran 4.25 times faster on the Mac II than on the Mac Plus. This is roughly what you'd expect.

Next, let's look at all three sets of floating-point benchmarks (Float and Savage). These dramatically show the difference between using SANE (standard Apple numeric environment, Apple's floating-point package on the Mac) on the Mac Plus, using the 68881 via SANE on the Mac II, and using the 68881 on the Mac II directly. Moving from Mac Plus/SANE to Mac II/SANE yields a performance increase of 8.5 for both Float and Savage. Moving from Mac II/SANE to Mac II/68881 yields a performance increase of 5.5 for Float and a whopping 41.9 for Savage. The overall boost in speed going from Mac Plus/SANE to Mac II/68881: 48.3 for Float and 353.8 for Savage.

Finally, compare the times of the non-floating-point benchmarks for Lightspeed C and Mac C on the Mac II. Despite the fact that Mac C is generating 68020-specific code, the Lightspeed C versions are faster for every benchmark. The biggest difference is in the Dhrystone, where Lightspeed C is 20 percent faster than Mac C. On the other hand, Mac C's direct access of the 68881 chip can make a tremendous difference in floating-point operations.

For more performance information on the entire Macintosh product line, see table 2, which contains benchmark times measured by the BYTE staff.

Table 1: *Benchmark results for the Macintosh Plus and Macintosh II. "LSC" refers to Lightspeed C version 2.01; "Mac C" refers to Mac C version 5.04 for the 68020/68881. The benchmarks are described in more detail in "A Closer Look" by Richard Grehan, in the September BYTE.*

Benchmark	Mac Plus/LSC	Mac II/LSC	Mac II/Mac C
Dhrystone	724	2631	2106
Fib	247.3	58.9	83.8
Float	125.7	14.4	2.6
Savage	1910.6	226.2	5.4
Sieve	56.2	11.9	16.7
Sort	89.0	19.6	23.2

Table 2: *Benchmark timings for the Macintosh product line, using the C language benchmarks described in "A Closer Look." All times are in seconds, with the exception of the Dhrystone results, which are in Dhrystones per second. Consulair's Mac C 68020 compiler version 5.04 was used with the 68020 processors, and Mac C version 5.04, which produces 68000 code, was used for the 68000 processors. "SE/HC" is a Mac SE using General Computer's HyperCharger 68020 accelerator board, and "SE/LP" is a Mac SE using Levco's SE Prodigy 68020 accelerator board.*

Benchmark	Mac II	Mac SE/HC	Mac SE/LP	Mac SE	Mac Plus
Dhrystone	2106	2176	2380	574	480
Fib	83.7	71.6	71.5	263.5	327.22
Float	2.6	4.0	2.6	230.2	228.3
Savage	5.4	8.9	5.2	1921	2049.2
Sieve	16.8	14.9	14.8	64.6	77.6
Sort	23.2	20.5	20.4	103.8	124.6

Problems

Given all the changes between the Macintosh II and its predecessors, problems were bound to happen. The original Mac design was a closed, fixed box, and the temptation among developers was to make assumptions about the hardware and software, despite Apple's warnings to the contrary. Apple itself faced challenges in moving toward the open architecture of the Mac II.

The single biggest hardware problem is the CPU bottleneck. Other than the standard 68881 math coprocessor, a truly intelligent move on Apple's part, there is very little distributed processing. Instead, the 68020 must draw each and every pixel on the graphics screen. A graphics coprocessor that intercepts many (or most) of the QuickDraw calls could enhance performance tremendously, as could direct-memory-access circuitry for the disk drives.

The biggest software problem is incompatibility. There are several reasons for this, some of which are Apple's fault, some of which are the developers' fault, and some of which are just inevitable.

Apple's biggest problems center around bugs in the ROM and the operating system (currently, version 4.1). I've talked with a number of developers, some with large third-party firms, who have been frustrated by the impact that Apple's bugs have had on their products. Some manufacturers have had to make quick patches to their programs, because it's necessary to work around some of Apple's bugs.

Many software incompatibilities, however, are due to poor planning on the part of the developers. Apple has been warning developers for months not to depend on absolute memory locations (other than specifically defined system globals), not to presume anything about screen dimensions (which results in those stuck windows I described earlier), and especially not to use programming techniques incompatible with the 68020.

One major source of problems has to do with the 68020's instruction cache. In this cache, the 68020 keeps the last 64 instructions that it has executed, along with the address (in memory) of each. When the 68020 is about to fetch its next instruction, it checks first to see if that instruction is already in the cache. If so, it loads the instruction from the cache, avoiding a fetch from memory and thus

speeding up execution. Small chunks of code, such as tight loops, can fit entirely inside the cache, enhancing performance dramatically.

Why does this cause problems? Because some programs, particularly those with copy protection, use self-modifying code. If the original, unmodified instructions are still in the cache, then they are executed instead of the modified ones. In another form of the same problem, usually involving system I/O calls, a set of instructions is created in some unused portion of memory (such as on the stack) and then executed. If two such calls are made close together and are created at the same locations, the cache may still contain the instructions from the first call and may use those instead of the ones just created.

Unfortunately, the Mac II has no provisions for disabling the 68020 cache. This is a real deficiency, since the 68020 does have a cache-disabled mode, and most of the 68020 accelerator boards for the Mac Plus and Mac SE allow you to disable the cache via a desk accessory. Given the flexible nature of the System 4.1 Control Panel, I'm surprised that Apple did not implement such an option. However, at least one public domain application (cachectrl) and one FKEY (Disable Cache) have surfaced to let you do this.

Finally, here's a hard one for me to make a call on: Virtually every paint-style application mashed the screen display when I used more than 1 bit for the pixel depth, either in gray-scale or in color. Although the program still functions, several patches of gray or color garble the upper portion of the screen. MacPaint 1.5, SuperPaint 1.0, and FullPaint 1.0 (which had been hacked to operate on a Mac SE) all did this. I corrected the problem by setting the colors to 2 in the control panel, but it's a nuisance swapping between modes.

Because of mistakes by both Apple and the developers, about 10 percent to 20 percent of the Macintosh programs on the market, at the time of this writing, won't work on the Mac II. That percentage should shrink significantly by the time this review sees print. In fact, Apple itself is already trying to correct problems with its own programs by offering an update plan for owners of MacTerminal, MacDraw, MacProject, and MacWrite.

The Open System

The Macintosh II is probably the best and most important product that Apple has released since the original Apple II. It represents the end of the closed-box legacy of the original Mac and a return to the open architecture that continues to sell the Apple II, despite its age and obsolescence.

However, much like the current 80386 systems, the Mac II is a tad underbaked. Little software exists to take advantage of the Mac II's power, and current software suffers from compatibility problems. While Apple did a lot of things right, there was still some shortsightedness at work.

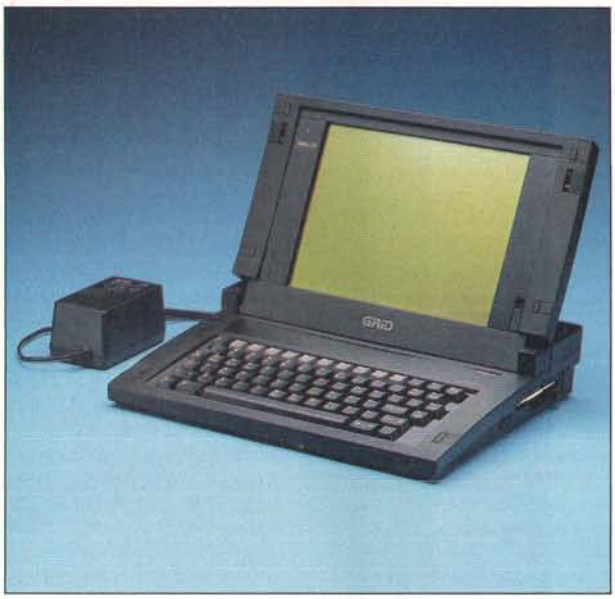
Should you buy a Macintosh II? If you've got the money and the need, then, yes, the Mac II is worth buying. It has some of the drawbacks of any new architecture, but it has the advantages as well: speed, power, and expandability. Most important, it has tremendous third-party support, and those third-party manufacturers will transform the Mac II into a far better machine than it is now.

Three years ago, I described the original Macintosh as "a gem—rough, slightly flawed, but a gem nonetheless." Those same words apply just as well to the Macintosh II, but with one important difference: Here's a gem that you can cut and polish yourself. ■

The GRiDLite Laptop

John Unger

Grid's portable:
A mixed bag of advanced features and mundane hardware



The GRiDLite Model 1032 laptop differs from GRiD's earlier portables, which had rugged magnesium cases, custom ROM modules, and high price tags. The GRiDLite 1032 has a lower price ($1750), a high-impact plastic case, and up to a megabyte of ROM.

This machine's hardware represents a "bad news/good news" story. The 80C86 CMOS CPU runs at 4.77 megahertz, and the standard machine has only one 3½-inch floppy disk drive, 128K bytes of RAM (the 1032 with 640K bytes of RAM is $600 extra), and a 3- to 4-hour battery lifetime. There are no slots for accessory boards other than an optional modem.

On the good news side, the supertwist LCD display is bright and easy to read, and you can put a megabyte of ROM in this machine. The rest of the system is comparable to other laptops and includes a parallel and a serial port, a port for an IBM CGA–compatible color monitor, a connector for an external 3½-inch disk drive, and provision for an internal 1200- or 2400-bit-per-second modem.

A Closer Look

The GRiDLite 1032 is about the same size as other laptops, and its single disk drive and small battery keep its weight down to 9 pounds. Two sliding latches on the top front edge of the case unlock and raise the screen. There is sufficient friction in the screen's hinges to let you set it at any angle between about 60 and 120 degrees.

The laptop comes with an internal 9.6-volt, 1-ampere-hour nickel-cadmium battery and an external combination power supply and battery charger. After only 3 to 4 hours of use, the red warning light on the keyboard begins to glow. If you need longer battery life, you can either purchase another internal battery (changing the battery is a trivial task) or buy the optional external nickel-cadmium battery pack, which lasts about 10 to 12 hours.

The GRiDLite's one 720K-byte, 3½-inch floppy disk drive is located at the rear of the right side of the computer, which means that you need some clearance on that side to get the disks in and out. A small green LED at the top of the keyboard glows when the disk drive is being accessed.

A second external 3½-inch disk drive is available as an option. The disk drive is powered through the drive cable that plugs into a dedicated DB-25 connector on the rear of the computer. This allows the drive to be quite small (4¼ inches wide, 1½ inches high, and 6½ inches deep). The cable connector adds about 2½ inches to the depth of the drive.

The system's eight ROM sockets can accept either 64K-byte or 128K-byte ROM or EPROM ICs. Four of the sockets hold either 28-pin or 32-pin ROM chips; the other four sockets hold 28-pin GRiDLite ROM cartridges. These are much easier to install than standard ROM packages because the pins don't bend as easily.

My review system came with six ROM sockets filled. Three sockets contained GRiD's Integrid DOS shell software. A fourth had MS-DOS 3.2's COMMAND.COM, hidden system files, and a few DOS utilities. Crosstalk was loaded on two GRiDLite ROM cartridges. The remaining DOS utilities and the PC-to-GRiD communications program are on floppy disks. GRiD offers a variety of software on ROM chips, at the list price of the software plus $50. You get all the manuals and the original disks in addition to the programs in ROM.

You can buy the GRiDLite with either 128K bytes, or, for an additional cost of $600, 640K bytes of RAM. You can buy either 512K bytes or 1024K bytes of additional RAM for the 128K-byte GRiDLite. This RAM is compatible with the Lotus/Intel/Microsoft Expanded Memory Specification (EMS) and is installed as a piggyback module under the floppy disk drive. GRiD also includes a RAM disk program. Adding memory chips to the GRiDLite is not a user option; it must

continued on page 204

John Unger (P.O. Box 95, Hamilton, VA 22068) is a geophysicist for the U.S. government. He writes graphics software and uses computers to study the structure of the earth's crust.

The Wang LapTop

Alex Lane

Wang's portable: A bridge between Wang and PC computing environments

To the designers of the Wang LapTop computer ($3530), IBM PC compatibility was a secondary consideration. Wang's LapTop computer is chiefly a Wang-compatible remote terminal capable of running PC software. This 14¼-pound machine features an 8-megahertz, 16-bit NEC V30 CPU, 512K bytes of RAM, and a 10-megabyte hard disk drive. Built into this laptop are a Wang communications interface (you need the optional Wang Systems Networking software), a thermal-transfer printer, and a rechargeable nickel-cadmium battery that supplies power for up to 4 hours.

With the LapTop computer, you get a power supply, a roll-paper attachment, a roll of paper, a set of system disks, a carrying case, documentation, and a pair of function-key overlays. The case, however, is large enough to hold only the computer and a few disks. The standard software includes MS-DOS 3.2, GWBASIC 3.2, and Wang enhancements such as diagnostics, system utilities, and Wang's Industry Standard PC-emulation mode.

My review machine had the following options: an external numeric keypad, one 3½-inch and one 5¼-inch external floppy disk drive, a 512K-byte memory expansion card, and a 2400-bit-per-second internal modem. The total cost for the laptop and options was $5998.

A Hefty Package

When closed, Wang's LapTop looks more like a small portable typewriter than a computer. The rear half of the machine contains a thermal dot-matrix printer, complete with platen knob, paper slot, and release lever.

The LapTop weighs 14¼ pounds and measures 14 inches wide, 12 inches deep, and 4 inches high. It is one of the larger and heavier laptops, and it is definitely intended for two-handed use, even down to the LCD screen's latches on both sides of the machine.

On the computer's left side is the RS-232C serial port and a pair of jacks for the telephone line and handset. On the right side is the power switch, a jack for the numeric keypad, a printer switch, and the SCSI port. The rear panel contains only an adapter plug for the 21-volt DC power supply. The parallel port is conspicuously absent. (Wang makes only serial printers.)

High Performance

Unlike the Intel 8088, with 16-bit architecture and only eight address lines, the LapTop's 8-MHz NEC V30 is a true 16-bit microprocessor. The performance difference shows in the LapTop's Sieve and Calculations benchmark times. Wang's LapTop is 20 percent faster than the 7.16-MHz Toshiba T1100 Plus, and 60 percent faster than the 4.77-MHz IBM PC.

The LapTop comes with 512K bytes of RAM, and you can install another 512K-byte memory module in a dedicated slot in the back of the machine. Unlike PC clones that are limited to 640K bytes of addressing, the Wang LapTop can use the entire megabyte when running Wang software. In Wang's Industry Standard PC-compatible mode, the DOS 640K-byte address space can be supplemented by a 400K-byte RAM disk.

Wang offers two internal Hayes-compatible modems (1200- and 2400-bps) that share the serial interface with the RS-232C serial port; when the modem is on, the serial port is disabled. You can turn on the modem and control its configuration via a Wang utility program and a communications menu.

The LapTop's hard disk drive is fast. Its BASIC Disk Write and Disk Read times come in at 18.3 seconds and 14.3 seconds, respectively. The hard disk also tolerates transportation well. After I commuted with the LapTop for a month, the format procedure reported the appearance of only one bad sector out of over 2400. To conserve battery power, you can make the hard disk stop spinning when it hasn't been accessed for a time. (You specify the time in the CONFIG.SYS file.)

Although putting a 10-megabyte hard

continued on page 205

Alex Lane (c/o Reynolds, Smith and Hills, P.O. Box 4850, Jacksonville, FL 32201) is a senior software engineer.

continued from page 202

be performed by GRiD technicians.

The optional 1200-bps internal modem furnished with my computer functioned perfectly. It was completely Hayes-compatible and worked fine with Crosstalk, Qmodem, and ProComm.

Keyboard

Squeezing all the functions of a full-featured, IBM-type keyboard onto the GRiDLite's 71 keys requires some compromise in convenience. GRiD uses a shift-type Function key in combination with other keys to invoke functions, in the same way as IBM's Shift key is used. Some keys can invoke up to four functions if they are used with both the Function and Shift keys. Twelve numbered function keys are arranged in a row at the top of the keyboard. You can access ten of these directly; the remaining two do double duty as the Insert and Delete keys and have to be pressed with the Function key to respond as function keys.

A numeric keypad is superimposed on keys of the main keyboard, and GRiD supplies a utility program to make access to them as easy as possible. However, the layout is not very convenient, and I preferred sticking to the normal number keys along the top of the keyboard.

This keyboard has full-size keys with a good feel, but they give no audible feedback and call for a lighter touch than I am used to. Four editing keys at the right end of the keyboard act as arrow keys and as PageUp, PageDown, Home, and End when used with the Function key. This layout worked well for me.

Display

The supertwist LCD screen is one of the GRiDLite's strong points. It gives superior contrast without power-hungry backlighting and can be viewed from as much as 45 degrees off to the side.

This screen features blue-black characters on a yellow-green background. The characters are well-formed from an 8- by 8-pixel matrix, and the standard text mode is 80 characters by 25 lines. The GRiDLite supports both CGA 320- by 200-pixel and 640- by 200-pixel graphics modes. However, there appear to be only three, or possibly four, distinct shades of blue-gray in CGA mode. You have to adjust the contrast carefully to discriminate between the two darkest shades.

The screen is 8½ inches wide by 6½ inches high, which gives an aspect ratio of 1.3 to 1 (width to height). This value is the same as that of most CRT monitors, which means that graphics figures, such

continued on page 206

GRiDLite Model 1032

Company
GRiD Systems Corp.
47211 Lakeview Blvd.
Fremont, CA 94538
(415) 656-4700

Size
11⅛ by 13⅓ by 2⅝ inches; 9 pounds

Components
Processor: 4.77-MHz 80C86
Memory: 128K bytes of RAM, standard, expandable to 640K bytes on system board; up to 1 megabyte of optional internal EMS RAM; up to 1 megabyte of ROM
Mass storage: One 720K-byte double-sided, double-density 3½-inch floppy disk drive; optional second 3½-inch floppy disk drive
Display: LCD supertwist, 25 lines by 80 columns; 320- by 200-pixel color graphics or 640- by 200-pixel monochrome graphics; screen size: 8½ by 6½ inches
Keyboard: 71 keys, including 12 function keys; special editing key cluster; embedded numeric keypad selectable on ASCII keyboard
I/O interfaces: RS-232C serial port; Centronics-compatible parallel port; external floppy disk drive port for optional 3½-inch disk drive; RGB video port (IBM PC–compatible); standard telephone jack for internal modem
Other: Internal nickel-cadmium rechargeable; approximate lifetime, 3 to 4 hours

Software
MS-DOS 3.2, GWBASIC 3.2; file-transfer and other utilities

Options
640K-byte RAM expansion: $600
External 3½-inch floppy disk drive: $295
External nickel-cadmium battery pack: $175
512K-byte EMS RAM: $295
1024K-byte EMS RAM: $395
Hayes-compatible 1200-bps modem: $395
Hayes-compatible 2400-bps modem: $595

Documentation
46-page *GRiDLite Owners Guide* (includes index); 24-page *Using MS-DOS and the GRiDLite*; 290-page *MS-DOS 3.2 Reference Manual* (includes index); 423-page *GWBASIC User's Guide* (includes index)

Price
Base Model 1032 with 128K bytes of RAM: $1750

Wang LapTop

Company
Wang Laboratories Inc.
One Industrial Ave.
Lowell, MA 01851
(617) 459-5000

Size
14 by 12 by 4 inches; 14¼ pounds

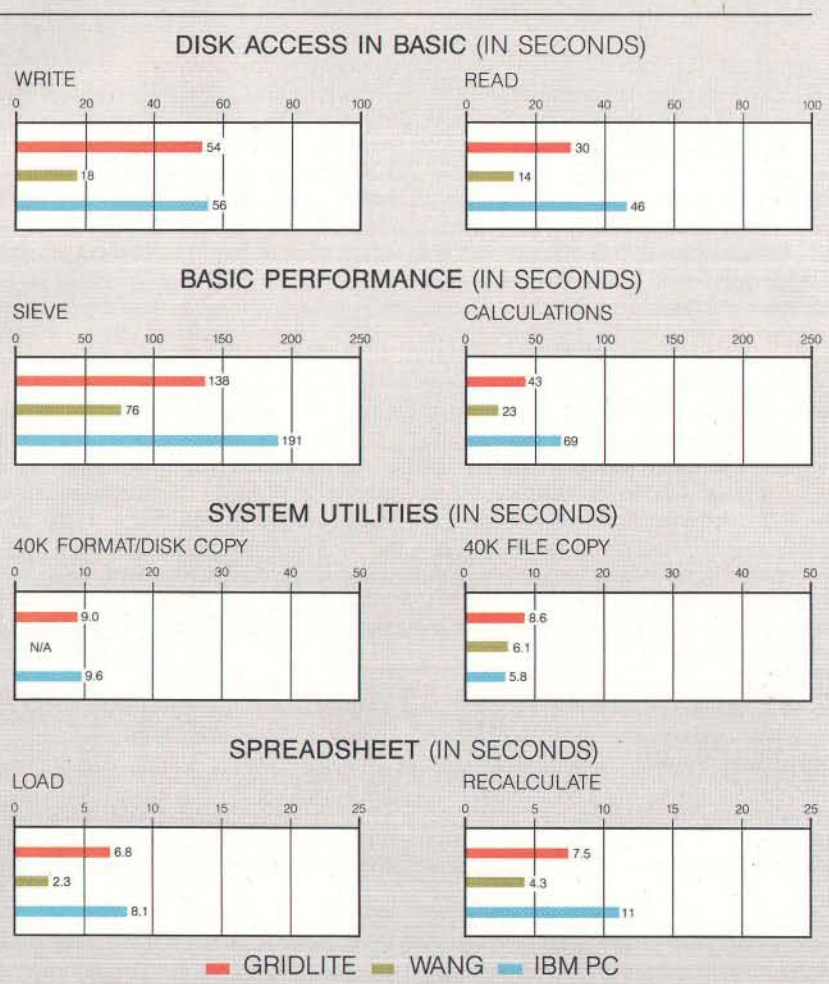
Components
Processor: 8-MHz NEC V30
Memory: 512K bytes of RAM standard, expandable to 1 megabyte
Mass storage: 10-megabyte internal hard disk drive; optional external 3½- and 5¼-inch floppy disk drives
Display: 80-column by 25-row supertwist LCD, emulates IBM CGA in monochrome; screen size: 9 inches by 4 inches
Keyboard: 90 keys, including 16 function keys; optional numeric keypad
I/O interfaces: Optional 2400-bps asynchronous or synchronous/asynchronous modem; RS-232C serial port; SCSI port
Other: Built-in thermal printer; rechargeable nickel-cadmium batteries (12-volt sub-C pack); approximate lifetime (with printer and modem on): 4 hours

Software
Proprietary Wang; MS-DOS 3.2; GWBASIC 3.2

Options
3½-inch 720K-byte external floppy disk drive: $518
5¼-inch 360K-byte external floppy disk drive: $365
Numeric keypad: $95
512K-byte RAM expansion: $695
1200-bps modem: $425
2400-bps modem: $795
Wang Systems Networking software: $400
Wang Integrated Word Processing: $385
Wang Asynchronous Communications software: $100
Car lighter attachment: $25

Documentation
Fundamentals Guide; Troubleshooting Guide; Modem User's Guide; Asynch User's Guide; DOS Command Processor Guide; Printer Software Administration Guide; Installation Instructions; BASIC Guide; PC User's Guide

Price
System unit: $3530 (includes system software with GWBASIC, MS-DOS 3.2, carrying case, roll-paper attachment, roll of paper, power supply, battery, and function-key overlays)



The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a blank, formatted floppy disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it takes to format and copy a 40K-byte file using the system utilities. The Spreadsheet graphs show how long it takes to load and recalculate a 25- by 25-cell spreadsheet in which each cell equals 1.001 times the cell to its left. Tests on the GRiDLite were done using MS-DOS 3.2, GWBASIC 3.2, and Multiplan 1.06. The GRiDLite had one double-sided, double-density 720K-byte internal floppy disk drive, one external 720K-byte floppy disk drive, and 640K bytes of RAM. Tests on the Wang LapTop were done using Wang GWBASIC 3.2, Wang's Industry Standard DOS, and Multiplan 1.06. The LapTop tested had the 10-megabyte internal hard disk drive and 360K-byte and 720K-byte floppy disk drives. Test times for both of the Wang's floppy disk drives were identical, so the charts indicate only one figure for both drives.

continued from page 203

disk drive inside the LapTop is laudable, not having a built-in floppy disk drive is annoying. If you travel and must carry software and data, you'll soon tire of lugging a disk drive about in a separate case.

The LapTop's external disk drives communicate via the SCSI port, which lets you connect up to six other disk drives or peripheral devices. The disadvantage of SCSI is a lack of compatibility with some PC software. The Norton Utilities is a notable example: The software expects to deal with a standard PC disk controller.

The LapTop's 3½-inch disk drive can run on rechargeable batteries, or you can connect it and the computer to the power supply via a T connection. The 5¼-inch disk drive uses only AC power and comes with a connecting cable to attach it either to the system unit or to the back of the 3½-inch disk drive. The 3½-inch drive uses 720K-byte disks, so you can't do a DOS `DISKCOPY` to or from the 5¼-inch disk drive.

The performance of both external disk drives compares favorably to the drives installed in other laptops. The Read (29.66 seconds) and Write (31 seconds) benchmark results of both of the LapTop's external disk drives are as fast as the fastest disk drive (Toshiba T1100 Plus—Read 30 seconds, Write 31 seconds) of the laptops reviewed in "Four Portable Computers" by John Unger in the February BYTE.

Keys and Pixels

The LapTop's keyboard, like other Wang keyboards, resembles a pre-PC typewriter. Sixteen function keys are arranged horizontally above the full-size QWERTY keyboard. These keys, along with the shift key, give you 32 functions. The keyboard is comfortable and easy to adapt to, with one major exception: The Control key is small and is located in a cramped position to the left of the space bar. DOS programs like XyWrite, which use control-key sequences, are difficult to use with this keyboard. Also, the gray plus and gray minus keys are found only on the separate numeric keypad, making it difficult or impractical to use packages like Framework without the keypad.

If you input a lot of numeric data, I strongly suggest that you obtain the numeric keypad. The keypad's functions are toggled by the F16 key, which doubles as the Num Lock key. When not in Num Lock mode, the keypad's functions are the same as the IBM PC's numeric keypad.

The LapTop's 9- by 4-inch screen is an 80-column by 25-line supertwist LCD

continued on page 207

continued from page 204

as pie charts, will look the same when displayed on the GRiDLite's screen.

Specialized Software

MS-DOS treats the files residing in the special ROM packages as though they are on the A: drive. One peculiarity of this system is that you can have two identical files with the same name in a directory—one in ROM and the other on the disk. If you execute a program that exists both in ROM and on the disk, the system will run the version from the disk. The `CHKDSK` command adds the amount of ROM to the amount of disk space on drive A:.

The MS-DOS 3.2 operating system provided with the GRiDLite includes specialized utility programs and unique versions of standard MS-DOS programs, designed specifically for this machine. The `MODE` command is a good example. With the GRiDLite, you can use this command to turn on power to the modem or the serial port, to switch the COM1: device between the modem and the serial port, or to change the the size of the cursor. GRiD's version of MS-DOS also includes an extremely useful HELP utility program that supplies information about using DOS commands and functions.

ROM-based software can be beneficial on a laptop. For example, in my review computer, the operating system kernel was in ROM; this meant I saved disk space because I never had to format a disk with the /S option to include the MS-DOS system files and COMMAND.COM. In addition, the machine booted much faster from a cold start. If you need them, you can simply have AUTOEXEC.BAT and CONFIG.SYS files on the disk in the A: drive. The convenience of having a communications program like Crosstalk in ROM is twofold: First, it's always there when you want it; and second, it doesn't take up any disk space or RAM until you need it.

The GRiDLite uses Phoenix Corp.'s highly IBM PC–compatible ROM BIOS 2.03. I had no trouble running any of my IBM software on the laptop.

Performance

The GRiDLite's performance is adequate but not outstanding. The main reasons it does better than the IBM PC in the benchmarks are its 80C86 chip, versus the 8088 in the IBM PC, and the improvements in version 3.20 of GWBASIC. The GRiDLite outperforms the Toshiba T1100 Plus when the Toshiba is running in its 4.77-MHz mode, and in disk I/O operations even when the T1100 Plus is running at 7.16 MHz. The figures are impressive. The GRiDLite did the Sieve benchmark in 138 seconds; the Toshiba T1100 Plus at 4.77 MHz took 142 seconds. The GRiDLite did the 40K-byte File Copy benchmark in 8.2 seconds; the T1100 Plus (at high speed) took 11.4 seconds.

Because the GRiDLite lacks an external 5¼-inch disk drive, there are two options for transferring files and programs between a PC and the GRiDLite; both use a null modem cable between the serial ports of the PC and the laptop. The first and most direct method simply uses a communications program, such as PC-Talk or Crosstalk, running on each machine, to upload and download files from one machine to the other. The second method, and the one GRiD recommends, involves using GRiD's PC master/slave software (included with the DOS utilities) to set up one of the computers as a master node and the other as a slave. To the master micro, the slave machine looks like a logical disk drive with a normal letter designation (e.g., E:). You can then issue DOS commands, such as `COPY` and `DIR`, from the master machine to examine and transfer files from one machine to the other. Don't expect high-speed transfer rates from either of these methods; 9600 bps from the serial port is tops.

Pros and Cons

The GRiDLite Model 1032 is a curious mixture of advanced, specialized features and mundane hardware. Its 4.77-MHz clock rate clearly compromises its performance, and its short battery life hurts its usefulness as a truly portable laptop computer.

Moreover, the 90-day warranty period for the computer is short compared with the one-year warranties of the IBM, Zenith, and Toshiba laptops. GRiD will sell you an extended warranty for $180 when you buy the machine; an expanded warranty, which includes a loaner while your machine is being fixed, costs $540. The user pays the initial shipping cost, and GRiD pays the return freight.

On the other hand, having a megabyte of applications software at your fingertips in ROM is clearly an advantage for any portable computer, and the GRiDLite's LCD display is one of the best I have used.

However, I would not recommend the machine for someone who is looking for a laptop capable of doing desktop-like computing and who needs higher performance and expansion capability. Compared with the latest versions of the Toshiba T1100 Plus ($2099 with 640K bytes of RAM), the Zenith Z-181 ($2399 with 640K bytes of RAM), and the NEC MultiSpeed ($2195 with 640K bytes of RAM and two drives), the GRiDLite's performance is not up to par; it has fewer features; and it is not as good a value. ■

continued from page 205

that provides a 7-to-1 contrast ratio. The screen resolution is either 320 by 200 pixels or 640 by 200 pixels in CGA mode. A jack in the side of the screen lets you remove the LCD screen and connect an external color monitor. The screen pivots easily to any position to take advantage of available lighting, since supertwist screens generate no light of their own.

Printer

The integral thermal dot-matrix printer works with either thermally sensitive paper or with a ribbon cartridge and normal printer paper. The printer-control switch turns the printer on and off and also adjusts the darkness of the print.

The LapTop's printer is slow (18 characters per second). A 64-character by 55-line page of text took about 6½ minutes to print in both medium and dark print modes. The ribbon cartridge gets used up rather quickly—I'd estimate that about 20 single-spaced pages can be printed from one cartridge.

The printer uses either single sheets or continuous-form paper, but since the printer has no tractor mechanism, continuous-form media drifts a bit. Two dedicated keyboard keys retract or advance the platen to simplify paper loading and unloading. The machine comes with one roll of paper and an attachment that hangs from the back of the computer. The attachment folds up, but it and the paper do not store gracefully.

Software

The unit I reviewed came with seven 5¼-inch disks: four disks (1.3 megabytes) of system files including DOS 3.2 and GWBASIC 3.2, one diagnostics disk, a printer-support disk, and an installation disk. Wang's optional Integrated Word Processing and Asynchronous Communications packages are on two 3½-inch disks.

When you power up, the CONFIG.SYS file boots the machine into Wang mode and asks if you want to change the time and date. Pressing the EXEC key produces Wang's main system menu. You can now go forward or backward through the menus by using the EXEC and CANCEL keys, respectively.

Selecting `DOS Command Processor` from the main system menu spawns an offspring session of DOS 3.2, identified with the prompt `[Wang] C>`. At this prompt, you can run the SYSMODE utility to switch the machine from Wang mode to what Wang calls "Industry Standard" mode (i.e., PC mode). If you don't run SYSMODE first, attempts to load and run most DOS programs will cause the machine to stop working. I ran Framework II, WordStar 3.3, and Turbo Prolog 1.1 with no problems. A list of "tried-and-found-true" DOS programs was included with the computer, and the documentation acknowledges that not all PC-compatible programs will run.

Wang's Integrated Word Processing is functionally the same as that used on the Wang VS and PC systems. The Asynchronous Communications software gives you telephone-line communications at 300 to 2400 bps, and direct connection to minicomputers and mainframes at 9600 bps.

Technical Support

The LapTop comes with an impressive array of documentation: six small three-ring notebooks that cover everything from taking the system out of the packing boxes to the nuances of the system software. On a practical level, the only problem with having so much documentation is knowing where to find what, and what to take with you when you travel.

As a Wang customer, you are assigned a customer number, which you should have handy when you call. You can call the toll-free number and directly punch in the type of support you are calling for if you have Touch-tone service. Once connected, you are assigned a tracking number for future reference should your problem not be resolved immediately.

Despite not having a customer number, I was not denied support. After a mild interrogation (i.e., name, company, machine serial number), I was given a temporary number. Once past the gates, I found Wang's technical-support people friendly and competent.

Form and Function

When you consider it against the backdrop of PC compatibility, the Wang LapTop computer scores in the mediocre range. It lacks appeal to PC users because of its limited DOS compatibility and unusual keyboard, which cause difficulty with some DOS-based software. From a performance standpoint, I am impressed with the speed of both its processor and its disk drives. I transported the LapTop daily to a real office environment to do real work, and had no problems. Also on the plus side are the internal 10-megabyte hard disk drive and the SCSI port. On the minus side, however, I missed having a built-in parallel port and an internal 3½-inch floppy disk drive.

If your office uses Wang equipment and is considering buying laptops, you should definitely give this machine a careful once-over. If what bothered me doesn't bother you, this LapTop may be just the ticket. ■

GRAPHICS TOOLS FOR SOFTWARE DEVELOPERS

What is HALO?

HALO is a device independent library of 190 graphics subroutines. It is compatible with 17 programming languages and over 110 graphics hardware devices for the IBM PC, PS/2 and compatibles. It provides the software designer with the richest environment of graphics functions; the programmer with reliable and well-documented tools; and DP managers with continuity of user interface and database format.

Who uses HALO?

Since its introduction in 1982, HALO has developed an installed base of 60,000+ end-users, hundreds of site-licensed corporations, government agencies, universities, and national laboratories, and most importantly, a family of over 150 Independent Software Vendors (ISVs) who market applications written with HALO.

What about performance?

Our ISVs are the best proof of HALO's performance. They use HALO because:

- —building their own library costs too much
- —HALO outperforms the rest
- —HALO is easier to program
- —it supports a wider range of devices for a bigger potential market
- —new device drivers are added quarterly to prevent software obsolescence and reduce maintenance costs.

HALO™
infinite possibilities in graphics and imaging

How much does it cost?

A single license for HALO costs $300.00 and includes all device driver and your choice of one compiler binding.

HALO is fully documented, includes LearnHALO (an interactive tutorial) and free 800# technical support.

If you need high performance graphic development software that provides a migration path to OS/2 and other future technology, follow the industry leaders—call **(800) 426-HALO.**

media cybernetics
8484 Georgia Ave.
Silver Spring, MD 20910
(800) 426-HALO
(301) 495-3305 telex 322014

The Definicon DSI-780

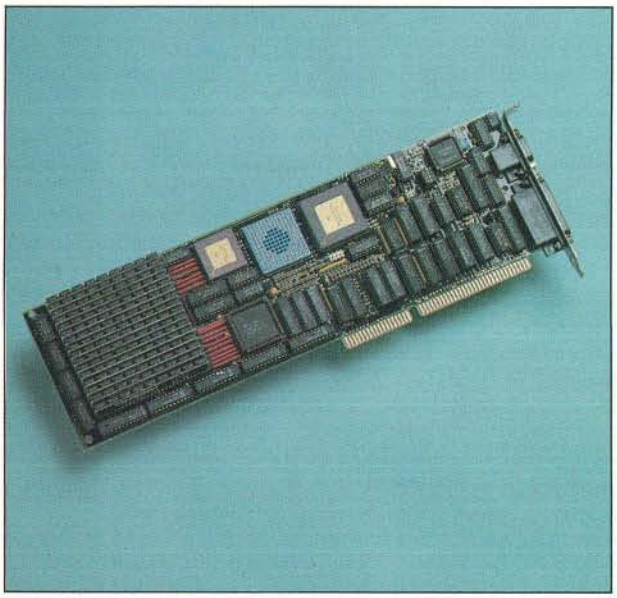
Dave Thomas

A 68020-based XT/AT coprocessor for scientific and engineering applications

Are you frustrated sharing your VAX with 10 other scientists? Do you wish you could run your finite-element analysis in your engineering office, rather than at that expensive service bureau? Do you need a development machine for both Intel and Motorola CPUs? Then the DSI-780 may be the PC coprocessor you need.

The DSI-780 from Definicon Systems runs in the IBM XT, AT, and true compatibles. The board uses the Motorola MC68020 CPU and the 68881 floating-point coprocessor. Multitasking software provided by Definicon allows both an AT-based application and a 780-based application to execute concurrently.

For most 68000 applications, the Definicon board is more than adequate. However, it does not provide the full Unix environment that some developers require.



On the Board

The DSI-780's MC68020 CPU and the MC68881 floating-point unit (FPU) run at 16.67 megahertz with no wait states (20- and 25-MHz models are also available). Definicon offers boards in various configurations ranging from $1000 for the DSI-020 (12.5 MHz with 1 megabyte of RAM) to $12,000 for the 25-MHz, 16-megabyte RAM model. (The version of the board that I reviewed had 4 megabytes of 120-nanosecond RAM). The board has an expansion socket for a promised Motorola memory-management-unit chip. Additionally, the DSI-780 is equipped with a 2681 dual universal asynchronous receiver/transmitter (DUART), which drives two RS-232C ports, accessible via DB-9 and DB-25 connectors at the rear of the board.

Software for the board includes both system software and compilers. System software consists of a hardware diagnostic, a minimal assembler, two loaders, and source-level debugger. Definicon offers C, FORTRAN, and Pascal compilers, as well as a BASIC interpreter/compiler and two assemblers (all at additional cost—see page 212 for details).

The Definicon board's communication area resides at address D000:0000 of the IBM AT and at address E000:0000 of the IBM XT. This area is a 64K-byte segment through which the board and DOS talk to one another using three special ports: the control port (at address 2A0 hexadecimal), the page-select port (2B0), and the secondary page-select port (2B8). The secondary page-select port is used on the DSI-780 boards with more than 4 megabytes of RAM. Software running on the XT/AT uses these ports to map the 64K-byte memory window onto any page in the 4-megabyte address space of the 780. This architecture facilitates the development of cooperative multiprocessing applications.

I reviewed the DSI-780 board installed in a Packard Bell AT-compatible computer. The Packard Bell was running at 8 MHz with one wait state, and I used MS-DOS 3.1 as the operating system. The machine had an 80287 FPU (also running at 8 MHz), a 1.2-megabyte floppy disk drive, and no hard disk drive. I ran all test programs from a 4-megabyte RAM disk (unless stated otherwise), using two 2-megabyte JRAM cards from Tall Tree Systems, and their supporting software. I had no difficulty installing the board using the instructions provided.

The DSI resident MS-DOS interface lets the board communicate with the operating system using either polled or interrupt mode. (I used interrupt mode for my tests.)

Software

The DSI-780 I reviewed came with Definicon system software and Silicon Valley Software's (SVS) BASIC-Plus interpreter and C, Pascal, and FORTRAN compilers (all were version 2.6). Each compiler package consists of three disks containing the Definicon system software, SVS utilities, and the associated SVS compiler. The system disk contains several programs to test that the DSI-780 board's components are functioning properly, as well as a monitor/debugger

continued

Dave Thomas (School of Computer Science, Carleton University, Ottawa, Ontario, Canada K1S 5B6) is an associate professor of computer science at Carleton University and is a moderator of the BIX Smalltalk conference.

and the loader program. The SVS utilities disk contains the error message files for all three compilers, an object code generator, an assembler, and a linker.

The loader program is responsible for loading files from the host computer into the DSI-780 and for regulating communication and program control between the host and the DSI-780. The loader manages the communications memory area and ports and performs the following functions: It resets and initializes the DSI board; determines the presence and type of DSI board; loads the operating system into the DSI board; resets and transfers control to the DSI board; and services requests from the DSI board until termination.

When the DSI-780 requires service, the loader obtains the service-request information by looking in the interprocessor communication area. From this information, the loader determines the requested service—writing a character to the screen, reading information from the disk, and so on—and begins work on it. When the loader has finished the requested operation, it resets a specific memory location (referred to as the 8086SVC location). While the host CPU is performing its task, the DSI-780 continues with its own operations. However, if the DSI-780 requires another service and the host CPU is not finished, the 780 will wait for the loader to reset the 8086SVC location.

The Definicon loader is actually a DOS shell that allows software executing in the DSI-780 to issue DOS and BIOS calls. I was very impressed by the loader, which cleverly intercepts the calls and forwards them to the AT via a TSR (terminate-and-stay-resident) program. The DSI loader makes performing a compilation and executing the result on the DSI-780 as natural as doing it on the host PC. Since the DSI-780 uses DOS for all file and screen I/O, there is no need for special file formats or terminal I/O. Also, if you install the DSI multitasking loader, you can compile on the DSI-780 and continue working on your PC.

All three compilers performed well. They provide clear, concise error messages for compilation errors, and they let you choose to abort or continue the compilation when an error occurs.

The SVS compilers adhere closely to the standards for their respective languages. FORTRAN-77, for example, insists that you arrange the declarations in a particular order. Pascal accepts few, if any, of the extensions found in some Pascal compilers available for PC-DOS. Such compliance is fine if you're developing new code, but it's very frustrating

continued

The DSI-750+

Last spring, Definicon Systems announced the DSI-750+, which supersedes the DSI-780. Although the 750+ represents a redesign of the 780 board layout, for all intents and purposes it operates identically to the 780. Many of its features are identical to those of the 780: Both are full-size AT-style boards, the installation is the same, you can run the same software (I used the same executable file for benchmarking both boards), and expansion connectors are pin-compatible.

It is interesting to note, however, that although the 750+ operates at 16 MHz, it uses select 12-MHz components. (You can jumper it for 12-MHz operation if you're skittish about running components beyond their rated speeds, but I ran the board at 16 MHz with no problems.)

The 2681 DUART, which is standard on the DSI-780, is optional on the DSI-750+. If you order the board without the DUART in place (this is the configuration I reviewed), then you must operate the board in polled mode, because in interrupt mode the host actually interrupts the 68020 via the DUART. Engineers at Definicon indicated that there was little difference in performance between the interrupt and polled communication protocols, and in fact, when I compared benchmark results of an interrupt-mode DSI-780 with a polled-mode DSI-750+, I found no discernible difference between them.

Table A shows the results of the standard BYTE BASIC benchmarks when executed under SVS BASIC-Plus on the DSI-750+. These figures are very close to those obtained on a DSI-780; the differences are negligible. Next, I ran the C benchmarks that BYTE has been using in the New Generation articles (see table B). Again, the DSI-750+ turns in times so close to those of the DSI-780 that you really can't tell the two apart.

If there's so little difference, why bother producing a new product? Engineers at Definicon told me that the layout and components of the new board make it easier for Definicon to manufacture it. Also, I noticed only one back-of-the-board jumper fix on the 750+, as opposed to several on the back of the 780, so Definicon has probably cleaned up problems in the circuit layout. If you're really concerned about the 12-MHz parts of the 750+, Definicon still manufactures the DSI-780 for people who believe that only 16-MHz CPUs should run at 16 MHz.

Table A: *Standard BASIC BYTE benchmarks for the DSI-750+. The board tested was plugged into an IBM PC AT running at 8 MHz. All times are in seconds.*

	DSI-750+ (16 MHz)	DSI-750+ (12 MHz)	IBM PC AT (8 MHz)
Read	25	25	24
Write	27	27	26
Sieve	6	8	80
Calculations	4	6	27

Table B: *The C benchmarks for the DSI-750+. These benchmark programs are described in "A Closer Look" by Richard Grehan in the September BYTE. All times are in seconds, except for the Dhrystone, which is in iterations per second.*

	DSI-750+ (12 MHz)	DSI-750+ (16 MHz)
Dhrystone	2428	3200
Fibonacci	64.67	48.58
Float	2.98	2.22
Savage	7.45	5.63
Sieve	6.45	4.82
Sort	9.13	6.91

Aztec C ... The Best C
Frees the genius in you

You've got a great idea . . .
. . . you're ready to write your programs.

You don't want to be sidetracked by all the paperwork. With Manx Aztec C and the ingenious **make** function, your creative processes won't get bogged down in program administration and housekeeping. Manx Aztec C has the most sophisticated, hardworking program administrator available to you. Once you've described your project, adding new features or enhancements is simple. You never have to concern yourself with the repetitive, tedious task of rebuilding your systems.

The development process moves quickly. Compiles, assemblies, link edits . . . all finish in record time.

Manx Aztec C is the fastest, most efficient C development system in the industry. Benchmarks show it . . . reviews commend it . . . users praise it.

You're ready to test the program. You're ahead of schedule. The Manx Aztec C Source Level Debugger shows you the exact C language statement giving you a problem. You fix the problem quickly . . . you're still ahead of schedule.

You've got some time for fine tuning. The Manx Aztec C Profiler examines your program, tells you where the slow spots are and validates your test procedure. A few changes and it's exactly what you wanted.

You've made it!

Aztec C is available for MS-DOS/PC DOS. Call for details on Macintosh, Amiga, Apple II, CP/M-80, CP/M-86, TRS-80, ROM and others.

To order, or, for information

Call Today

1-800-221-0440

In NJ or outside the USA call (201) 542-2121

30-day satisfaction guarantee. Special Discounts are available to professors, students, independent developers, and on a "trade-in" basis. Site licenses.

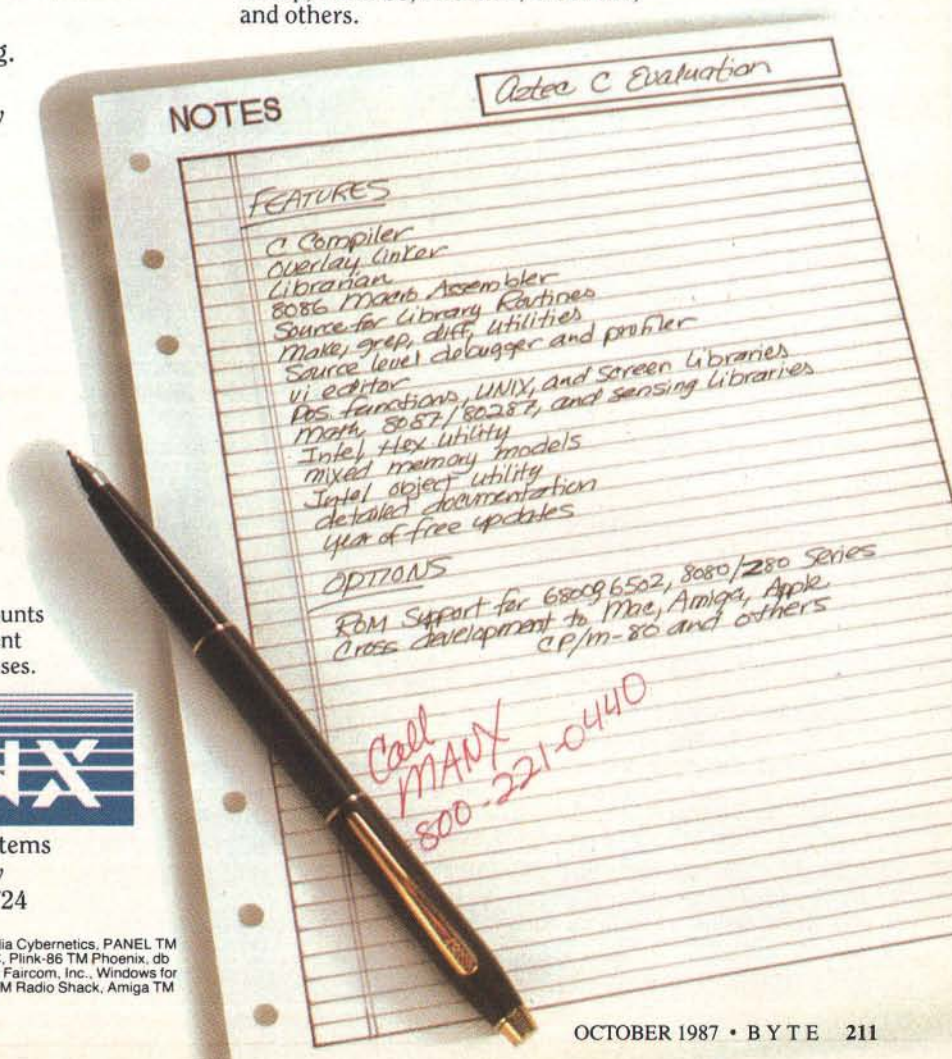
" . . . a superb linker, a profiler, an assembler, and a set of development utilities are only the beginning of this package . . . performed admirably on the benchmarks, with short compile times and the best link times in this review . . . includes the most professional make utility . . . documentation is clear and complete. There is no doubt that this is a valuable and powerful programming environment." **Computer Languages Feb. '86**

" . . . execution times are very good, close to the best on most tests . . . " **PC Tech Journal Jan. '86**

" Easily one of the fastest compilers overall . . . library provides a lot of flexibility . . . generates small .EXE files." **Dr. Dobbs Journal Aug. '85**

C'Prime (Compiler, Assembler, Linker)	**$ 99.**
Aztec C 86-d Developer's System	**$299.**
Aztec C 86-c Commercial System	**$499.**
PC ROM (8086, 68000, 8080, or 6502)	**$750.**

Third Party Software for Aztec C: HALO, PHACT, C-tree, PRE-C. Windows for C, PC-lint, PANEL, Greenleaf, db Vista, C-terp, Plink-86, FirsTime, C Util Lib, and others.



MANX

Manx Software Systems
One Industrial Way
Eatontown, NJ 07724

Circle 161 on Reader Service Card

for people converting existing code. The quality of the compiler-generated code, while adequate, is not as efficient as that generated by the popular GreenHills compilers available on the DSI-32 under Unix. [Editor's note: *See "The DSI-32 Coprocessor Board," a two-part article beginning in the August 1985 BYTE.*]

The SVS assembler is adequate for coding small procedures to be called from C, FORTRAN, or Pascal; otherwise, it's very limited. For example, I took a programming example from another 68000 assembler package, and the SVS assembler gave error messages for the directive `XDEF` (used to declare external definitions) and for an absolute jump instruction, `JMP $2428`. Also, there is no manual provided for the SVS assembler, so it was a little difficult to get started. Definicon recommends the Quelo Assembler (a macro-assember product also available for the DSI-780) for any serious assembly language work.

Debugging with SDB

One of the major difficulties of developing software for add-in coprocessor boards is debugging a program resident on the board. Definicon provides both a traditional machine-code debugger (similar to the PC-DOS DEBUG program) and a symbolic-level debugger. SDB, the symbolic debugger I reviewed, was a beta copy, but nevertheless I found it very useful. SDB runs on the host processor (8088 for the XT or 80286 for the AT), which means that all the DSI-780's memory is available for the applications program. All the basic debugging commands are provided, including data display, tracing, and breakpoints.

SDB worked with C, Pascal, and FORTRAN programs. One minor annoyance is SDB's case sensitivity to routine names. This is awkward for users who have programs composed of routines written in a mixture of C, Pascal, and FORTRAN.

In summary, while SDB is definitely not as powerful as Microsoft's Code View (the symbolic debugger that Microsoft provides with its C compiler), it is a useful and essential tool for debugging programs executing on the 68020.

Documentation and Support

The documentation was adequate, but it could have been more detailed, better organized, and indexed. The lack of an index in the SVS manuals forces you to search through the entire DSI-780 manual to find a particular feature. Also, the SVS manuals make no reference to the routines contained in PASLIB (the Pascal library), CLIB (the C library), or FTNLIB.P (the FORTRAN library). The SDB manual does not describe the debugger's commands in any logical order.

In contrast to the problems with the documentation, Definicon's technical support is excellent. I used the company's BIX conference (dsi.32bit) frequently, and I received prompt responses to technical questions both electronically and by phone. [Editor's note: *Definicon also operates the Thousand Oaks bulletin board system at (805) 493-1495 for 2400-/1200-bit-per-second calls and (805) 492-5472 for 1200-/300-bps calls. The system is on-line 24 hours a day with software and support for Definicon's products, including the DSI-780.*]

Performance

I used both the BYTE benchmarks and a more traditional scientific test to see if the DSI-780 measured up (see table 1).

It is interesting to observe the figures returned by the Write benchmark. Since all file I/O is handled by the host computer, the speed of the disk write will depend largely on the speed of the host computer. But if you compare the results obtained by the DSI-780 board against those produced by the Packard Bell alone, you'll see that the times from the DSI-780 are faster. This is because the DSI-780 handles some of the job of manipulating the text buffer and leaves the task of writing to the buffer to the host. When the Packard Bell is operating on its own, it has to manage both of these tasks.

Since my major interest in the DSI-780 was its ability to do fast computation, I ran the Whetstone, Dhrystone, and LINPACK tests. I ran LINPACK, an application benchmark, to get a better feel for the speed of the DSI-780. LINPACK is a FORTRAN benchmark developed at the Argonne National Laboratory. It solves a dense set of linear equations, which makes it a useful test of CPU performance in scientific applications.

Although LINPACK produces a number of results, two of them are particularly noteworthy. The first is the Cray Ratio, which is a measure of the CPU power relative to a Cray supercomputer (hence, a Cray scores a 1.0 on this test). The DSI-780 board returned a Cray Ratio of 132.3 on the double-precision LINPACK, while a VAX-11/780 with a floating-point accelerator scored an 89. The second measure is an estimate of the floating-point performance of the machine in millions of floating-point operations (MFLOPS). On this test, the DSI-780 scored a 0.0928, and the VAX-11/780 scored a 0.14 (a Cray scores a 12).

A Cost-Effective Alternative

The benchmarks show that for many applications, the DSI-780 approaches the speed of a VAX-11/780. [Editor's note: *See the text box "The DSI-750+" on page 210 for a speed comparison of the DSI-780 and the DSI-750+.*] You can use this board as a stepping-stone to bring mature mainframe applications into the PC environment. Unfortunately, the SVS

continued

Definicon DSI-780

Type
68020 coprocessor board

Company
Definicon Systems Inc.
1100 Business Center Dr.
Newbury Park, CA 91320
(805) 499-0652

Size
Standard XT/AT full-length expansion card; 13⅓ by 4 by ¾ inches

Features
16.67-MHz 68020 CPU; 16.67-MHz 68881 FPU; expansion socket for MMU; 4 megabytes of on-board memory; uses 8-bit bus (XT) or 16-bit bus (AT); MS-DOS interface software; 68020 DOS-compatible kernel; 68020 memory is memory-mapped into the PC address space

Hardware Required
IBM PC XT, AT, or true compatibles; hard disk drive or RAM disk recommended

Software Required
MS-DOS 2.0 or higher, or Concurrent PC DOS 4.1

Options
SVS C compiler: $398
SVS Pascal compiler: $448
SVS FORTRAN compiler: $528
SVS BASIC-Plus interpreter: $248
Lattice Logic LTD Pascal compiler: $448
Living Software BASIC-to-C converter: $348
QUELO Macro Assembler and utilities: $198
Library Manager: $48
Public-domain disks (4): $20
Graphics-support disks: $188
SciTech scientific package: $314

Documentation
104-page user/reference manual

Price
DSI-780/4 (with 4 megabytes of RAM and 68020 running at 16.67 MHz): $3295

If you ever wanted to take a crack at assembly language, now's the time.

You probably already know that assembly language subroutines are the smartest way to get the fastest programs.

But if the complexities of working in assembler made you think twice, here's some good news. We've made Microsoft® Macro Assembler Version 5.0 a lot easier to use.

We eased the learning process by giving you the best support around. We completely revised our documentation. The new Mixed Language Programming Guide gives you step by step instructions for linking your assembly code with Microsoft QuickBASIC, C, FORTRAN, Pascal and other languages. And you get a comprehensive reference manual with listings of the instruction set and examples of each instruction. We didn't stop there, though. You also get an on-disk collection of templates and examples.

We've also dramatically simplified the high-level language interface. In just a few simple steps, you can be calling Macro Assembler subroutines from programs written in your favorite language.

Now that you're writing the fastest programs, Microsoft is giving you the fastest way to debug them. For the first time, we've added our CodeView® debugger to Macro Assembler. With source code and comments on your screen, Microsoft CodeView makes debugging programs containing assembly language subroutines a snap.

And you'll be glad to know that you don't sacrifice any speed for all the ease of use.

We took the fastest Macro Assembler on the market and made it even faster.

So what are you waiting for? Get your hands on Microsoft Macro Assembler and see what it's like to break your personal speed limit.

Microsoft®

For more information or for the name of your nearest Microsoft dealer, call (800) 426-9400. In Washington State and Alaska, (206) 882-8088. In Canada, call (416) 673-7638.

Table 1: *Benchmarks comparing the 16-MHz DSI-780, running SVS BASIC-Plus on a Packard Bell 8-MHz AT clone, with the Packard Bell alone running GWBASIC. The Read and Write benchmarks are the standard BYTE BASIC benchmark programs to read and write a 64K-byte file. The Sieve benchmark is a BASIC program that closely follows the Sieve benchmark BYTE uses to test C compilers (10 iterations). The Calculations benchmark is the standard BYTE benchmark extended to 100,000 iterations. All times are in seconds.*

	DSI-780	Packard Bell
Read	25.6	26.0
Write	27.0	48.8
Sieve	66.6	587.9
Calculations	36.1	317.7

FORTRAN-77 compiler is not mainframe-quality, so you should expect a week to a month of conversion time if your code is very machine-dependent. Note, too, that the DSI-780 does not provide virtual memory; therefore, you must be sure that your board has the appropriate amount of real memory to accommodate your application.

Some developers, no doubt, will be frustrated by the fact that the DSI-780 does not operate with Unix. However, I found the process of developing software using the Definicon MS-DOS interface to be straightforward.

In addition, unlike Definicon's DSI-32 board, with the DSI-780 you don't have to partition your hard disk into a Unix area and a DOS area and run two different operating systems: The DSI multitasking loader lets you run simultaneous DOS-based editing and 68020 compilation tasks.

What kind of applications are best suited to the DSI-780? Obviously, those that require a linear address space and need lots of CPU power. Typical examples include finite-element analysis, simulation, and font generation. For these and similar applications, the DSI-780 can offload the mainframe and provide a cost-effective solution for PC-based computation.

If Definicon continues to evolve this product (and, particularly, to improve the compilers available), I may consider canceling my order for a Mac II and permanently disconnecting my line to the mainframe. ■

Laser Printer Times Four

Wayne Rash Jr.

The new generation of laser printers is coming within the price range of individuals and small businesses. More manufacturers are offering their own versions of printers based on different laser-printer engines. These new laser printers offer a bewildering array of font styles, memory options, and methods for controlling output. For this comparison review, I looked at four relatively recent entries covering a wide price range: the Hewlett-Packard LaserJet Series II ($2595); the Kyocera F-1010 ($3695); the Okidata Laserline 6 ($1995); and the Epson GQ 3500 ($2199).

The Engines

In most cases, a laser-printer manufacturer buys the actual printing engine from another company, usually one that makes photocopiers. Hewlett-Packard, for example, uses a Canon engine, while the Epson and Okidata printers are both built around engines made by Ricoh. Kyocera builds its own engine.

The major differences between engines relate to the cost of supplies and the life of the machine. Canon was the original maker of low-priced laser-printer engines. The Canon engine uses a cartridge that contains both the toner and the photosensitive drum. This makes it easy to replace supplies when the toner runs out, and it keeps your hands clean.

However, the photosensitive drum, the device that transfers the image to the paper, does not wear out as quickly as the toner runs out. So, when you throw out the expended cartridge from a Canon-engine laser printer, you throw out a perfectly good drum in the process. [Editor's note: *Several companies now advertise that they can recharge your old Canon cartridges for considerably less than the price of a new cartridge. Laser-printer manufacturers, however, do not recommend using recharged cartridges because of possible excessive wear on the photosensitive drum and lack of quality control over the toner supplies.*]

Printers based on the Ricoh and Kyocera engines avoid this problem; they have separate drum and toner cartridges. When the toner runs out, you replace only the toner cartridge. Unfortunately, it's also a lot easier to get toner all over yourself, as I found out more than once.

Of course, the engine is only part of the printer. The printer manufacturer adds electronics that can give an engine different capabilities (e.g., graphics-image size and resolution).

The Tests

To test the printers objectively, I ran a suite of tests that try to simulate actual day-to-day uses of laser printers. The tests include printing a full page of graphics and a full page of combined text and graphics, using every printer emulation available for each laser printer to test for compatibility. Each test was repeated at 75, 150, and 300 dots per inch.

To measure the actual throughput, as compared to the manufacturer's claimed page-per-minute (ppm) speed, I benchmarked these machines in two ways. The first method involved sending a 96K-byte, 30-page text document to the printer with the DOS `COPY` command. In the second method, I set the printers to produce 30 copies and then sent them a single page of text, again using the DOS `COPY` command. Ideally, for a given computer, the times of these two tests should have been the same. In practice, there were time differences.

I timed the printers by pressing the button on the stopwatch at the same time that I pressed the Enter key on the computer. Since the files were on the computer's hard disk, the delay before sending the file to the printer was minimal. I also tested the time it took the printers to run through their power-on, self-test, and warm-up sequences (see the results in the table at right).

I ran these tests on a Tandy 1200 HD with 640K bytes of memory. To test text throughput, I used WordStar version 4, which supports Hewlett-Packard and Apple laser printers. I mixed text and graphics with Ashton-Tate's Framework II version 1.1, and I generated graphics with Lotus's Freelance Plus version 2.

While all printers performed well with WordStar, Framework's word-processing capabilities eluded some printers. In this test, I generated a memo that included bold, underlined, and italic print, along with the normal print and embedded graphics. The graph was a simple

	HP LaserJet Series II	Kyocera F-1010	Okidata Laserline 6	Epson GQ 3500
Company	Hewlett-Packard 3000 Hanover St. Palo Alto, CA 94304 (800) 367-4772 (415) 857-1501	Kyocera Corp. 3165 Adeline St. Berkeley, CA 94073 (800) 367-7437 (415) 848-6680	Okidata 532 Fellowship Rd. Mount Laurel, NJ 08054 (800) 654-3282 (609) 235-2600	Epson America Inc. 2780 Lomita Blvd. Torrance, CA 90505 (213) 539-9140
Warm-up time (in seconds)	26.0	21.5	32.0	33.0
Time to print one page (in seconds)	29.0	22.0	27.8	29.1
Time to print 30 copies (minutes:seconds)	3:58.0	3:17.1	5:05.8	5:09.4
Time to print 96K-byte file (minutes:seconds)	5:49.0	3:13.1	5:05.9	5:07.0
Rated speed	8 ppm	10 ppm	6 ppm	6 ppm
Price	$2595	$3695	$1995 (includes Personality Module)	$2199
Resident fonts	6	40	15	7
Ports	Serial and parallel	Serial and parallel	Serial or parallel	Serial or parallel
Memory (standard)	512K bytes	1 megabyte	272K bytes	640K bytes
Memory (as reviewed)	2.5 megabytes	1 megabyte	656K bytes	640K bytes
Accessory prices	Font modules (20+): $150 to $330 each Download font disks (16): $200 each Memory boards: 1 megabyte: $495 2 megabytes: $995 4 megabytes: $1995	Download font disks: $150 to $195 each	Memory module, 384K bytes: $300 Additional Personality Modules: $200 each Multiuser Personality Module: $600	Memory board, 1.5 megabytes: $499 Font cards (15): $149.95 each Emulation cards (2): $169.95 each Large paper tray, 250 sheets: $499
Paper bins	Letter, legal, A4, Executive (7¼ by 10½)	Letter, legal, A4, B5	Up to legal-size	Letter, legal, half-letter, A5, A4, B5
Toner cost	$115 (including drum)	$29.95	$29	$29
Cartridge life	4000 pages	3000 pages	1500 pages	1500 pages
Drum life	(In toner)	10,000 pages	20,000 pages	20,000 pages
Engine life	N/A	300,000 pages	180,000 pages	180,000 pages
Documentation	*Getting Started With LaserJet Series II;* user's manual	User's manual; programming manual	Setup guide; printer handbook; software handbook	User's manual
Size (in inches)	18 by 19 by 8½	17¼ by 17½ by 13½	16 by 16½ by 9	16 by 16½ by 8½
Weight	50 pounds	65 pounds	37.8 pounds	35 pounds

bar graph placed in the middle of the memo.

The full-page graphics test used another bar graph, this one generated by Freelance Plus. This software package supports a variety of laser printers and prints at 300 dpi regardless of the memory available to the computer.

Emulation and Graphics

The full-page graphics test provided the opportunity to test the emulation compatibility of each printer. The LaserJet did no emulations; it is a de facto standard that the others try to emulate. The Epson, Okidata, and Kyocera printers all support the Hewlett-Packard and Epson emulation. The emulations are complete, except that the Laserline 6 could not produce graphics with Framework, although this package supports the Epson MX, which the Laserline emulates.

To create graphics images, your software must have the appropriate printer-driver software, and the printer must have enough memory to handle the graphics file. A rule of thumb is that 1 megabyte of memory is sufficient to support a full page of 300-dpi graphics.

The software packages that I tried used different methods to create the image that was sent to the printers. Framework generates the graphics image entirely in the computer's memory. On the 640K-byte Tandy 1200 HD, Framework could produce high-resolution images of only about 1½ by 2½ inches, regardless of the memory available in the printer. Freelance Plus builds the images in parts, and downloads one part to the printer before continuing with the next. Building and downloading images is not fast. A 300-dpi image took about 45 minutes to print on all the printers, and nearly all this time was taken up by the computer creating the image and sending it to the printers.

The time required to build and download an image is directly related to the resolution: A 150-dpi image takes only about 20 minutes, and a 75-dpi image

continued

about 10 minutes. Of course, the time spent waiting is also directly related to the speed of the computer.

Status Messages and Manuals

All the printers have some method for displaying their status—either a front-panel display or a printed status sheet. The LaserJet has a single-line 16-character LCD screen that is informative and easy to read and use. All the machines except the GQ 3500 can also print a status page. This page lists the current status of the printer, the available fonts, and the interface settings.

Each of the printers comes with a user's manual. These manuals share one trait: They are woefully lacking in examples of how to use the special features of these printers. For example, the instruction for printing multiple pages in the Epson manual is a very terse ASCII code: ESC m n. That's all, except for a repeat in decimal and hexadecimal code, and a note that you can't print more than 99 copies. There are no examples. Of course, most BYTE readers can figure out how to send an ESC m to the printer by writing a program in BASIC, but the method of setting the number of copies is not readily obvious. That *n* could stand for almost anything, from the decimal number 30 (for 30 pages) to Roman numerals. As it turns out, it's supposed to be an ASCII character, such as CHR$(30), but this is explained in an entirely different section. An unskilled user might never figure it out. While the Kyocera user's manual has some examples, it could use more. The other manuals are much worse. They are not adequate for an inexperienced user.

Hewlett-Packard LaserJet Series II

HP laser printers are the standard against which other laser printers for PCs are judged, not necessarily because it's the best, but because it is the most common. The Series II is the latest in the HP model line. It is smaller and less expensive than its predecessors, but it is just as fast, and it supports the same software as the earlier versions.

The LaserJet is rated at 8 ppm. In testing, it approached that speed only when printing the same page 30 times. It churned out the 96K-byte document in just under 5.5 ppm, and, in fact, took longer than either the Laserline 6 or the GQ 3500, which are rated at only 6 ppm. (Hewlett-Packard replied that the speed of the laser printer depends on the interaction of the software and hardware. Different system configurations produce different times.) The LaserJet was also no faster than the Laserline 6 or the GQ 3500 in the other benchmarks, with the exception of printing multiple copies of the same page.

The LaserJet is easy to use. The LCD readout gives you a menu of functions and fonts, and you can rotate through them and choose what you want. Unfortunately, the manual fails to mention that you have to turn the printer off and back on again for the choices to take effect.

Because of the LaserJet's generally good documentation, getting the printer installed and operating is a snap. The instructions and drawings lead you through installation of the toner/drum cartridge and hookup to the computer. As part of the installation process, the documentation shows you how to install the font cartridges and how to run the status sheets. The LaserJet gives you a status report that can run to several pages if you print out all the internal fonts.

The LaserJet has the largest selection of optional font cartridges and font disks. The font cartridges ($150 to $330 each) are easy to use; you just plug them in and then select them from the menu. The font disks ($200) let you download a font from your computer to the printer as needed.

HP includes a utility program with the LaserJet to send an individual font to the printer and to print a test page. You can do only one font at a time, and the download process is rather time-consuming. In addition, downloaded fonts take up memory space that otherwise could be used for storing a graphics bit image.

Another utility available for LaserJet users is called PCLPak. This software takes advantage of what HP calls its Printer Command Language. HP says that PCLPak runs on HP and IBM computers. I did not test it for this review.

HP does not indicate the life of the LaserJet; the company says that, with routine maintenance, the engine should last indefinitely. The average life for a toner/drum cartridge is 4000 pages. This is longer than in earlier models of Canon-based printers and is due to a new compact Canon engine (the LPB-SX).

The new engine also provides a new paper path. The pages are stacked face-down in correct order. The paper path takes a U-turn, so not all paper and envelopes will work, but a straight-through paper path with no turns at all is also available.

The LaserJet is a very quiet printer and consumes relatively little power. In fact, the standby power requirement is only 170 watts, which is well within the range of most home wiring systems, as is the printing power requirement of 870 W.

Kyocera F-1010

The F-1010 is the fastest, largest, heaviest printer discussed in this review; it's also the most flexible, and the most expensive. The F-1010 has been available longer than the others, and it uses Kyocera's proprietary engine. It emulates the LaserJet and the Epson FX-80, as well as the IBM Graphics Printer and Diablo, Qume, and NEC daisy-wheel printers. Its printer-control language, Prescribe, lets you include printer commands in text files instead of having to write programs in BASIC. The F-1010 supports a number of graphics and shading primitives, does graphs and charts by itself, and even does bar codes.

The F-1010 is rated at 10 ppm, a claim supported by the machine's benchmarks; thus, it is significantly faster than the other machines reviewed here. It also gets running in a hurry.

Installing the F-1010 is slightly more complex than the LaserJet, because the F-1010 uses a separate toner and drum. You have to install each of them, in addition to removing some packing material and installing a waste toner bottle and a cleaning pad. The toner cartridge and developer unit fit beneath a door on the top of the printer. The drum fits into the side, and the bottle and cleaning pad go inside. The waste toner bottle includes a cap so you can dispose of it without mess, but there is no provision for storing the cap.

The printer is relatively easy to operate. Setting printer attributes, such as the number of copies to print, is different from other printers, since there is no LCD readout. Instead, you can embed commands in text. You don't need to send escape codes. Printer control codes are preceded by the text sequence !R!, which is unlikely to be duplicated in normal text. Using this method, you can easily change typefaces, text size, and other printer attributes from within documents. You can also use a series of batch files from MS-DOS to set the printer up the way you want it.

The F-1010's control panel has a two-digit status display and several warning lights. Kyocera includes a quick-reference panel to help interpret the status codes on the display.

The Kyocera user's manual includes a respectable number of examples and is by far the most thorough manual of all the printers covered in this review. Most of the commands have adequate examples.

The printer also comes with the Prescribe programming manual, which tells you how to use the Prescribe printer-control language. With Prescribe, you can generate pie, bar, and line graphs by simply specifying the type of graph and the data points. The HP download fonts also work with the F-1010.

The F-1010 has an automatic page-

continued

rom As Low As

$346 With System Only

all For Details and Other ystem Configurations.

SiliCON SPECIALTIES

1-800-354-7330

MiT SYSTEMS TURBO PC/XT

256K Memory, 360K Brand Name Floppy Drive,
135 Watt Power Supply Slide Case,
AT Style Keyboard,
4-10 MHz Clock Speed,
(Keyboard Selectable),
8 Expansion Slots

FEDERAL EXPRESS FREE AIR EXPRESS SHIPPING You Pay The Ground We Pay For Air*

Hardware

PRINTERS

Alps
All Models ... Call
Brother Printers ... Call
Citizen Printers
MSP-10 ... $ 249
MSP-15 ... 315
MSP-20 ... 285
MSP-25 ... 385
Premier 35 ... 445
120D ... 159
Diablo
D-25 ... 459
635 ... 759
Diconics
150 ... $ 299
Epson Printers ... Call
Hewlett-Packard
Laser Jet Series II ... 1829
NEC
3510, 3550 ... 729
8810, 8850 ... 1059
P-6 ... 429
P-7 ... 619
P-9 ... 1035
Okidata ... Call
Panasonic
1080 I NEW ... Call
1091 I NEW ... Call
1092 I ... 295
1592 ... 375
1595 ... 419
3131 ... 229
3151 ... 369
Star Micronics ... Call
Toshiba
321SL ... Call
341E ... 665
351 Model II ... 899
351 Color ... 1029

TERMINALS

Qume
101 Plus Green ... $ 315
101 Plus Amber ... 315
Wyse
30 ... 285
50 ... 359
75 ... 565
85 ... 425

MONITORS

Amdex Monitors ... Call
NEC
Multisync ... $ 545
Other Models ... Call
Princeton Graphics Monitors ... Call

COMPUTERS

NEC
Multispeed ... $1419
Pansonic
Business Partner ... 719
Sr. Partner ... 969
Exec. Partner Dual Drive ... 1429
Toshiba
T-1100 Supertwist ... Call
T-3100 ... Call
AST
Six Pack Plus ... $ 139
Other Models ... Call
ATI
EGA Wonder ... 245
Hercules
All Models ... Call
Intel
All Above Boards ... Call
Paradise
Autoswitch 350 ... 205
Autoswitch 480 ... 279
5 Pack ... 99

DISK DRIVES

Bernoulli Box
10 Meg ... $ 865
20 Meg ... 1190
40 Meg ... 1720
*Segate 20 MG w/WD Controller ... 339
Plus Development
Plus Hard Card 20 Megabyte ... 609
Quadram
Quad EGA Plus ... 295
Tecmar
All Models ... Call
Video-7
Vega Deluxe ... 265
Zenith
1490 FTM ... 615

MODEMS

Anchor Automation
Anchor Express ... $ 185
Hayes
All Models ... Call
Prometheus
1200B w/Software ... 125
US Robotics
Password 1200 ... 149
Courier 2400 ... 335
Microlink 2400 ... 335

Software

MONEY MANAGEMENT

Dollars & Sense w/Forcast ... $ 92
Tobias Managing Your Money ... Call

TRAINING

Flight Simulator ... $ 27
Letc ... 38
Mastertype ... 23
Mind Prober ... 25
MS Learning DOS ... 27
PC Logo ... 69
Turbo Tutor II ... 23
Typing Instructor ... 27
Typing Tutor IV ... 27

DATA BASE MANAGEMENT

Clipper ... $375
Cornerstone ... 53
dBase III LAN ... 589
dBase III Plus ... 379
DB-XL ... 82
Eureka ... Call
Fox Base Plus 2.0 ... 195
Genifer ... 188
Knowledgeman II Promo Pack ... 319
Nutshell ... 75
Paradox 2.0 ... Call
PFS: Professional File ... 112
Q & A ... 195
Quickcode Plus ... 138
Quick Report ... 138
Rapid File ... 239
Revelation ... 449
Revelation Bump Disk ... 249
R:Base Clout (New Ver.) ... Call
R:Base Ext. Report Writer (New Ver.) ... Call
R:Base 5000 System V ... Call
R:Base Graphix ... 175
Reflex ... 79
VP Expert ... 47
VP Info ... 47

COMMUNICATIONS

CompuServe Starter Kit ... $ 19
Crosstalk XVI ... 88
Crosstalk Mark IV ... 109
Microsoft Access ... 137
Mirror II ... 33
Remote ... 88
Smartcom III ... 155

INTEGRATIVE SOFTWARE

Ability ... $ 55
Enable 2.0 ... Call
Framework II ... 395
PFS: 1st Choice ... Call
Smart Software System ... 409
Symphony ... 439

GRAPHICS/MICE

Chartmaster ... Call
Diagram Master ... Call
Energraphics 2.0 ... $269
Easy CAD ... 94
Fast CAD ... 1375
Freelance Plus ... 325
Generic CAD w/Dot Plot 3.0 ... 75
Harvard Graphics ... Call
IMSI Mouse (PC Mouse) w/Dr. Halo II ... 92
In-A-Vision ... 259
Map Master ... Call
Microsoft Buss Mouse 6.0 ... 106
Microsoft Chart 3.0 ... 249
Microsoft Serial Mouse 6.0 ... 119
News Room ... 31
News Room Professional ... 65
PC Buss Plus Mouse (New Ver.) ... 99
PC Mouse (New Ver.) ... 89
Printmaster ... 29
Print Shop ... 32
Signmaster ... Call
Turbo Graphix Tool Box ... 38
VP Graphix ... 47
Windows Draw!! w/Clip Art ... 163

PROJECT MANAGEMENT

Harvard Total Project Manager II ... $282
Microsoft Project ... 218
Super Project Plus ... Call
Timeline 2.0 ... 235

ACCESSORIES

Copy II Option Board ... $ 75
Masterpiece ... 84
Masterpiece Plus ... 97
Masterpiece Remote ... 107
Microsoft Mach 10 w/Windows & Mouse ... 322
MousePad by Mousetrac ... 9
Summasketch 12x12 Plus ... Call

ACCOUNTING

BPI-B/L, A/R, A/P, Payroll ... $ 159
Computer Associates – G/L, A/R, A/P ... 379
DAC Easy Accounting ... 38
DAC Easy Payroll ... 28
In-House Accountant ... 53
One Write Plus ... 140
One Write A/R, A/P, Payroll ... 125
Time Slips ... Call

WORD PROCESSORS

Easy Extra ... $ 79
Leading Edge Word Processor ... 25
Leading Edge W/P with Spell & Merg ... 59
Microsoft Word 3.11 ... 175
Multimate Advantage II ... 245
PFS: Professional Write ... 89
Smart Spell Checker ... 65
Turbo Lightening ... 55
Volkswriter 3 ... 136
Volkswriter Deluxe Plus ... 59
Volkswriter Scientific ... 235
Webster New World Writer ... 55
Webster Spell Checker ... 33
Webster Thesaurus ... 39
Word Perfect Executive ... 103
Work Perfect Library ... 54
Word Perfect (Ver. 4.2) ... 195
Wordstar w/Tutor 3.31 ... 162
Wordstar Pro Pack 4.0 ... 233
Wordstar 2000 Plus 2.0 ... 209

DESKTOP PUBLISHING

Harvard Professional Publisher ... $329
Newsmaster ... 48
Pagemaker ... 479
PFS: First Publisher ... 45
Ventura Publishing ... 465

DISKETTES

Maxell MD-2 Qty. 100 ... $ 83
Maxell MD-2HD Qty. 100 ... 185
Maxell M25 Qty. 100 ... 65
Sony MD-2 Qty. 100 ... 85
Sony 3 1/2 Qty. 100 ... 107.50
Sony 5 1/2 ... 80

LANGUAGES

Basic Compiler (Microsoft) ... $219
C Compiler (Microsoft) ... 249
Cobol Compiler (Microsoft) ... 385
Fortran Compiler (Microsoft) 4.0 ... 245
Lattice C Compiler ... 236
Macro Assembler (Microsoft) ... 83
Pascal Compiler (Microsoft) ... 165
Quick Basic 3.0 ... 55
Run C Interpreter ... 64
Ryan McFarlan Cobol ... 539
Ryan McFarlan Fortran ... 339
Turbo Basic ... 55
Turbo C ... 55
Turbo Jumbo Pack (New Ver.) ... 159
Turbo Pascal w/8087 & BCD ... 55
Turbo Prolog ... 54
Turbo Prolog Toolbox ... 55

UTILITIES

1 DIR Plus ... $ 46
Bookmark ... 40
Brooklyn Bridge ... 72
Carbon Copy Plus ... 105
Carousel 2.0 ... 29
Copy II PC ... 19
Copywrite ... 40
Corefast ... 189
Cruise Control ... 24
Cubit ... 25
Disk Optimizer 2.0 ... 29
Disk Technician ... 56
Double DOS 4.0 ... 25
DS Back-Up Plus ... Call
Fastback ... 80
Homebase 2.5 ... 40
Keyworks ... 49
Mace Utilities ... 48
Microsoft Windows ... 55
Norton Commander ... 36
Norton Utilities 4.0 ... 48
Note It Plus ... 45
Noteworthy ... 42
PC Tools ... 19
Printworks ... 36
Prokey 4.0 ... 69
Referee ... 38
Sidekick (Unprotected) ... 45
Sideways 3.1 ... 37
Smart Notes ... 40
SQZ ... 45
Superkey ... Call
Take Two ... 79
Turbo Editor Tool Box ... 38
Unlock A, or B Plus ... 32
Unlock D Plus ... 43
XTree ... 25

SPREADSHEETS

Cambridge Analyst ... $ 59
4 Word ... 55
HAL ... 104
Lotus 1-2-3 Ver. 2.01 ... Call
Lotus Manuscript ... 339
Lotus Report Writer ... 67
Multiplan 3.0 ... 108
Silk ... 138
Supercalc 4 ... Call
Twin Classic ... 35
VP Planner ... 47

American Express Card · VISA · MasterCard

- **No Charge for VISA and Mastercard**
- You Pay The Ground Shipping – We Pay the Air
- Ground Shipping & Handling $6.00
- Free Air applies ONLY to orders up to 10 lbs & Over $50
- All product carries a manufacturer's warrantee. All Guarantee, rebates, trial period privileges & promotional programs are handled by the manufacture only.
- No APO, FPO, or international orders, please.
- **Call before submitting P.O.'s – Ask for National Accounts**
- Personal and Company Checks Will Delay Shipping 3 weeks
- Prices, Terms & Availability Subject to Change Without Notice
- Add 5% for C.O.D. Orders
- **We Do Not Guarantee Machine Compatibility**

Mailing Address:
8804 N. 23rd Avenue/Phoenix, AZ 85021
Order Lines: Mon-Fri 7 a.m. - 6 p.m.
Saturday 9 a.m. - 1 p.m.
Order Processing: (602) 994-2552
10 a.m. – 3 p.m. Mon.-Fri.

ejection feature. After a user-specified time during which data is not received, the F-1010 automatically prints a page, even if there is no command to do so. You can select a time from 0 seconds up to 8½ minutes, or you can turn off the feature.

The F-1010, like the LaserJet, stacks the pages in a face-down pile in the order in which they were printed. The curl of the pages is slightly tighter than with the LaserJet, and a page will sometimes push the page beneath it out of the stack. There is no straight-through paper path.

The F-1010 will handle an enormous amount of paper. According to the company, the estimated life of the engine is over 300,000 pages. The toner lasts for about 3000 pages, but with the F-1010 you don't replace anything but the toner, which costs about $30. The drum can last for as long as 10,000 pages.

The F-1010 is a heavy-duty printer, and it shows. The machine weighs 65 pounds and requires 950 W maximum power. The cycling of its heaters causes lights sharing its circuit to flicker.

Okidata Laserline 6

At $1995, the Laserline 6 is the least expensive printer in this review. The price includes the required single-user Personality Module. The Laserline 6 emulates the LaserJet, as well as the Epson MX-80, IBM Graphics Printer, Diablo, NEC, and Qume. It is rated at 6 ppm.

The Laserline 6's Ricoh engine lives up to its rated speed. The benchmarks for this printer supported its speed claims, both in the 96K-byte document and in the single page repeated 30 times.

In some ways, the Laserline 6 was the easiest printer of the group to use. While it lacks an LCD screen, it comes with the LaserControl memory-resident utility program for the IBM PC and compatibles, which gives you complete control of most of the commonly used functions.

From the main menu you can choose the emulation you want to run, margin settings, font settings, download fonts, paper size, number of copies, and page orientation, among other things. The software even makes suggestions for the proper settings for various software packages. LaserControl will also support screen dumps of graphics images.

LaserControl supports HP download fonts, and these fonts work fine with the Laserline 6. The software keeps track of the subdirectory where the fonts are kept and downloads one or more of them on request. Unlike the HP software, LaserControl translates the somewhat cryptic filenames into English, so you can pick fonts by name and size.

The printer has a single-digit status display and a series of LEDs that indicate current status. The display panel includes buttons for the self-test and for switching off-line or on-line. The Laserline 6 also prints a status page and font test.

As with the other printers, there should be more examples in the user's manual. The LaserControl software partly compensates for this lack of information, because controlling the printer is somewhat easier with the LaserControl program.

In other respects, the manual is fine. The setup guide leads you through unpacking, installing, and hooking up your printer, in clear steps illustrated by carefully chosen photographs. Installation is easy, even for the novice.

There are a few more steps in getting the Laserline 6 running than there are in the same process for the LaserJet. This is mostly due to the use of the Ricoh engine, in which the toner is separate from the drum. Both of these have to be installed, but it's a simple process, requiring you only to snap the items into place and remove some shipping material. The process is faster and less complicated than for the F-1010.

The LaserJet emulation worked fine with the Laserline 6, but there were problems with the Epson MX-80 and the IBM Graphics Printer emulations. In both emulations, the Laserline 6 could not accept the Framework test file that mixed text and graphics. It would accept graphics for either emulation from Freelance Plus, and it would accept text from Framework and WordStar. Graphics screen dumps worked fine. The problem was with only those emulations and the mixture of text and graphics from Framework. That function worked fine in the LaserJet emulation.

A required Personality Module, inserted into the rear of the printer, provides emulation in the Laserline 6. This module also contains the parallel interface. Optional Personality Modules for serial input ($200) and for a three-person multiuser interface ($600) are also available.

The Ricoh engine that Okidata uses for the Laserline 6 is the same one Epson uses in the GQ 3500. Also, supplies such as toner and drums are easier to find, since they work with both the Laserline 6 and the GQ 3500.

The engine has a paper path similar to that of the LaserJet. Normal operation calls for the paper to be stacked face-down on the top of the printer, but it can be fed straight through and out the other side. The Ricoh engine makes this easy by the use of a knob that controls the paper direction. The engine allows manual feeding and can print envelopes.

The Ricoh engine life is rated at 180,000 pages, and the drum life is

continued

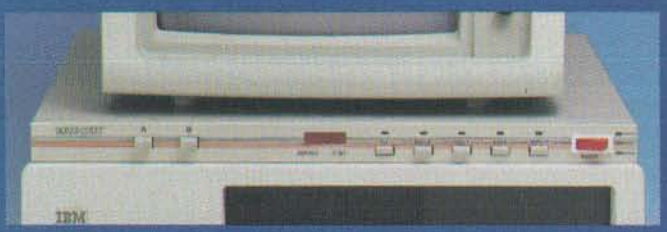
FEATURISTIC PROTECTION

The PC1025 by DATA SPEC

With full-featured convenience and sleek contemporary styling, the PC1025 is a new dimension in control protection.

Its slim-line design, color-matched to your PC, fits easily on top of your computer without intruding into your workspace.

The PC1025 combines the complete safety of system and modem surge protection, the easy convenience of five lighted power switches and a Master Switch, with the versatility of a built-in data switch. Added features include a digital clock, LED status lights, and more.



FEATURISTIC protection that gives you more system control and convenience than you thought possible from one source.

DATA SPEC®

THE ULTIMATE IN COMPUTER ACCESSORIES

A DIVISION OF ALLIANCE RESEARCH CORPORATION

20120 Plummer Street • P.O. Box 4029 • Chatsworth, CA 91313

IN JAPAN: DATA SPEC JAPAN LTD. Tokyo Japan.

20,000 pages. The toner cartridge has a normal life of about 1500 pages, which is shorter than the life of toner cartridges in the other printers. According to the manual, some of the toner goes to fill up spaces and channels inside the machine, so the initial toner cartridge lasts only about half that long.

The Ricoh engine's power requirements are comparatively modest—only 600 W at the most; this means the printer can share electrical circuits with other devices. It is also extremely quiet, even for a laser printer.

Epson GQ 3500

The GQ 3500 does not support LaserJet emulation without an add-on card, which was not available for this review. (The HP LaserJet and Diablo 630 emulation cards are now available.) Without emulation cards, you're stuck with Epson LQ emulation, and not all software supports it. Freelance Plus doesn't, so I could not perform the full-page graphics test.

The interface card on the GQ 3500 can be removed to reveal several sets of DIP switches. You can set the switches to emulate either the LQ 1500 printer or a generic, text-only line printer. A change to LQ is advisable if you plan to print graphics. Emulation cannot be set through software control.

Many printer functions must be set by software. This includes normal printer operations, plus those operations unique to laser printers, such as printing multiple copies. The GQ 3500 also allows the definition of circles, boxes, and shading.

The printer has a two-digit LED status display that keeps you posted on the progress of the printer as it warms up and goes through its self-test. It displays a combination of numbers and symbols, which can be translated using a function table on the top of the printer or a reference section on the control panel. The reference section is printed in dark-green letters on a black background and is difficult to read from a distance. The printer does not print a status page.

The speed benchmarks were similar to the Laserline 6's, reflecting the commonality of the Ricoh engine. While each test took a couple of seconds longer than on the Laserline 6, the claimed speed of 6 ppm was supported. The other details of the Ricoh engine operation are shared with the Laserline 6 and have been discussed in that section.

The Epson GQ 3500 is quiet and works well, but it misses the mark when compared to the competition. The lack of standard LaserJet emulation, or even Epson MX or FX emulation, is a serious handicap.

Final Printout

Laser printers are adding functions and dropping in price. The Okidata Laserline 6, Epson GQ 3500, and Hewlett-Packard LaserJet Series II are certainly examples of that, and they provide excellent value. The Kyocera F-1010 looks instead to features and speed, as well as an extremely long life. All these printers perform adequately.

Before choosing a laser printer, you must first determine your needs. Do you need fast text output or graphics? Will the software you use support a particular printer? Is there an upgrade path that will let you add fonts or memory to the printer? Because of the proliferation of new laser printers, you'll have to carefully examine the specifications for each. ■

Wayne Rash Jr. is a member of the professional staff of American Management Systems Inc. (1777 North Kent St., Arlington, VA 22209), where he consults with the federal government on microcomputers.

CTX

THE BEST 14" MONITORS IN BOTH WORLDS

CGA
EGA
VGA [PS-2]
MUTLI-SCAN / ANALOG

DUAL SCAN
GREEN / AMBER / WHITE
132 COLUMN

ALL WITH TWO-YEAR WARRANTY

U.S. HEADQUARTERS: CTX INTERNATIONAL, INC.
260 PASEO TESORO/WALNUT, CA 91789
TEL: (714) 595-6146 FAX: (714) 595-6293

EASTERN REGIONAL OFFICE
CONTINENTAL TECHNOLOGY, INC.
300 McGAW DRIVE
EDISON, NEW JERSEY 08837
TEL: (201) 225-7377 FAX: (201) 225-6355

NEW ENGLAND AREA
MICRO-REP
141 BROOKS ST., SUITE NO. 1
BRIGHTON, MA 02135
TEL: (617) 254-1489 FAX: (617) 783-4877

FACTORY
CHUNTEX ELECTRONIC CO., LTD.
ROOM 401, NO. 50 SEC.1,
HSIN-SHENG S. RD.,
TAIPEI, TAIWAN, R.O.C.
TEL: (02) 3921171 FAX: (02) 3919780

Circle 70 on Reader Service Card (Dealers: 71)

TOP–LAN™

NETWORKING!

THE MOST COST EFFECTIVE METHOD TO OBTAIN MAXIMUM PC AUTOMATION!

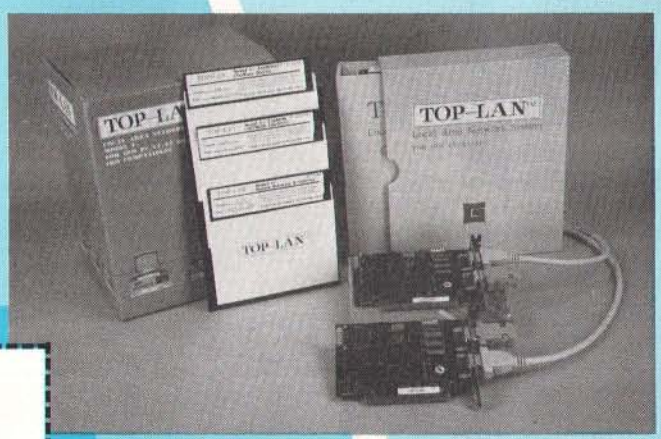
STATE-OF-THE-ART CONCEPT AND TECHNOLOGY!

The Top-Lan™ I+ system is the most cost effective method to obtain local area networking of personal computers for sharing resources. It's a system compatible with IBM and Novell networks. The I+ has highly productive capabilities for schools, offices, retail outlets (POS systems), factories and for cataloging.

STANDARD TOP-LAN™ I+ starter kit contains connections for two IBM PCs, XTs or ATs, including 2 top link interface cards, 10 meters of network cable, a pair of terminator plugs, installation and operation manual, operational file server software and drivers for Novell and IMB netbios. Future system expansion is convenient! Installation is quick! Access to the system is secure! It's a new system concept to maximize existing PC resources.

CONTACT TOP-LAN™ today for the application of a TOP-LAN™ I+ system to your operation. ALSO AVAILABLE: Autoboot card for remote stations, Ethernet E+ card, and other accessories to complete your installation.

ATTENTION DISTRIBUTORS, MFGRS. REPS: Call us today to get in on the ground floor of the TOP-LAN™ national distribution programs.



Call (913) 631-0021
or write for information

Send information on the TOP-LAN™ systems to:

Name _____

Address _____

City _____

State & Zip _____ Phone _____

Company _____

TOP–LAN™

11005 West 60th, Suite 320, Shawnee, KS 66203
P.O. Box 15945-312, Lenexa, KS 66215

*IBM is a trademark of International Business Machines Corp.
*Novell is trademark of Novell, Inc.

Circle 278 on Reader Service Card (Dealers: 279)

Three C Language Screen-Utility Packages for PCs

Jonathan Robie

A look at the Windows for Data, C-Worthy, and Vitamin C screen utilities

Writing an easy-to-use interface for a program accounts for a large part of the time spent developing applications, and it often accounts for the majority of the code. Screen utilities provide the programmer with high-level tools for developing windows, menus, and data prompts. The look and feel of the user interface in a prototype program can be rapidly modified because these packages supply libraries of ready-to-use screen and keyboard functions. Appropriate inputs from the user cause the library functions to call core functions that accomplish the program's purpose. Once all parties agree on the user interface design, the core functions can be written, tested, and integrated into the program.

The products reviewed here all provide for menus, data-entry forms, on-line help, and keyboard and windowing functions using the C programming language. Although they allow some flexibility in program design, these packages also make assumptions about the user interface that can be different from your own. You can obtain the source code for each product (usually at additional cost) and modify it to suit your needs. All three companies allow you to develop commercial programs with their packages without having to pay royalty fees.

The Packages

Vermont Creative Software's Windows for Data version 2.05 was built using the Windows for C version 4.12 windowing library, and the two packages together cost $395. I received both Windows for Data and Windows for C for this review, and I will treat them as one package. A free demonstration disk is also available. The two packages together including source code costs $1290. Although the package I reviewed is for use with MS-DOS, you can obtain versions that support the Unix, Xenix, and VMS operating systems.

Custom Design Systems' C-Worthy Library version 1.0 is marketed by Solution Systems and costs $295. C-Worthy is available with source code for $495. A free demonstration disk is available, and it contains the tutorial on disk. C-Worthy also supports a variety of MS-DOS computers that are not IBM PC–compatible (e.g., the TI Professional, Victor 9000, NEC APC III, and NEC PC 98) through the use of machine-specific overlays.

Vitamin C, from Creative Programming Consultants, costs $225 and includes the source code. It comes with two demonstration disks. If you return it within 30 days and have used only the demonstration disks, the company will refund your money. If you need source code for your program development, then Vitamin C will be significantly less expensive than the other packages.

I tested these products on an Epson Equity II computer with an NEC V30 CPU, 640K bytes of RAM, and a 20-megabyte hard disk drive. All three packages require a minimum of 256K bytes of RAM, and a hard disk drive is recommended for program development.

Windows

The data-entry, menu, and help facilities of these programs are built on extensive windowing libraries. Windows for Data's windowing libraries are sold as a separate product called Windows for C, which comes with its own manual. The other two programs document their windowing routines along with other routines. All three programs support multiple pop-up windows with borders and titles, text display with automatic word wrap and scrolling, and assignment of display attributes to a window.

C-Worthy and Vitamin C support virtual screens—windows that are larger than the screen display. You can only view as much of the contents as will fit in the screen display at a given time, so C-Worthy has a function that lets you scroll through the window manually, and Vitamin C automatically adjusts the window so the text at the cursor position is always visible. Windows for Data does not support virtual screens per se, but provides the same functionality through memory files. The term *file* is misleading: A memory file is an array of pointers to strings associated with a window that are treated like a file. These strings reside in the computer's memory for fast access. A function is provided that lets you scroll through the memory file and return control to the program by hitting the Escape key.

Keyboard Handling

I was pleased with the powerful keyboard-input routines in all three packages. Each lets you associate a function key with a C function that's executed whenever the keyboard-input routines detect a key press on the associated key. For example, in Windows for Data, you can define the F2 key to display a help screen by using `keyd_def(-K_F2, kdhelp())`, where `kdhelp()` is a help function. Each package supports keyboard-idle functions—user-written functions that execute whenever the input function doesn't detect new keystrokes for processing. A keyboard-idle function might be used to update the time display on the screen.

Only Vitamin C supports keyboard handlers and keyboard reassignment. Keyboard handlers are called prior to the Vitamin C input functions, allowing the handler to perform text filtering or conversion. The programmer can also reas-

continued

Jonathan Robie (c/o Software by Design, P.O. Box 26121, Lansing, MI 48909) is a freelance computer consultant. He has an M.S. in computer science from Michigan State University.

sign the keyboard definitions at run time. For example, the text editor has its own table of keyboard definitions, so you can have one set of assignments for the text editor and one set for all other data entry.

Menus

All three packages have high-level routines for creating and processing menus. Table 1 lists some of the menu features of these packages. Each package stores menus as a linked list of menu items. The first step to using a menu is to initialize the menu structure. In Windows for Data, the size and attributes of the menu are specified with this call. Vitamin C defines a menu style, then specifies that style in the initialization call. Since C-Worthy automatically determines the size, placement, and attribute of the menu, you simply declare the beginning of a list.

The second step is to declare the items on the menu. Windows for Data specifies the relative coordinates for each menu item and gives pointers to functions or submenus that are activated when the item is chosen. Vitamin C positions the items automatically within the menu, but, like Windows for Data, requires the programmer to specify the menu function in the definition call. C-Worthy takes a different approach: Instead of defining a function for each item, it calls a general-purpose function when the item is selected. This function handles all menu choices and has a single input parameter that stores the user-selected item. Other functions can be called or additional menus defined within this function.

The third step is to call a menu-processing function. In all three packages, this function handles the chores of highlighting menu choices, moving the cursor, and returning the user's response. The menu-processing function regains control after the item functions are called, and an item function can return a value to signal the menu processor to stop the program.

Although Vitamin C provides more options for pop-down and pull-down menus, Windows for Data places the menus on the screen automatically. This is a great convenience, because the placement of secondary menus depends on the location of the items on the primary menu, and Windows for Data will adjust the secondary menus automatically when the primary menu is altered. Like the other packages, Windows for Data lets you select a menu item by typing the first character, but, unlike the others, it does not allow the programmer to require confirmation. This makes it possible to develop menus where you accidentally make choices by hitting the wrong key.

C-Worthy does not provide pop-down or pull-down menus. Instead, C-Worthy automatically centers all menus on the screen and uses windows to display them. The active menu is highlighted by the menu-processing routine. This means that menus developed with C-Worthy have a consistent appearance, and it is easy to develop the menus because much of the work is done for you.

Table 1: *Menu options for the three packages. Vertical menus are menus in which the items are arranged from top to bottom. Lotus-style menus are horizontal; items are placed next to each other on a line. A pop-down menu is a pull-down menu that displays its contents without requiring a pull-down action. Pop-up and pull-down menus are two different ways of providing a second-level menu: Pop-up menus are displayed automatically when the item on the primary menu is selected; pull-down menus are displayed when the user highlights the item and requests the second-level menu with the Return key or the down arrow. Menu-level help is context-sensitive help that explains how to use the current menu; item-level help explains only the currently highlighted item. Item-level prompt strings are one-line prompts that appear when an item is highlighted to explain the purpose of the item. Initial character selection allows the user to choose an item on a menu by typing the first character. Default placement positions the menu on the screen without having the position specified by the programmer; manual placement allows the programmer to specify the location of the menu. A menu-processing function is a function that displays and controls the menus, calling the appropriate functions when choices are made. Check marks are marks that appear next to items on a menu to indicate program status. Separators and blank items are formatting options used to group items on a menu. Unavailable items are used to indicate that some options are currently inactive and cannot be selected.*

Menus	Windows for Data	C-Worthy	Vitamin C
Vertical	Yes	Yes	Yes
Lotus-style	Yes	No	Yes
Pop-down	Yes	No	Yes
Pop-up	Yes	Yes	Yes
Pull-down	Yes	No	Yes
Menu-level help	Yes	Yes	Yes
Item-level help	Yes	No	Yes
Item-level prompt strings	Yes	No	Yes
Initial character selection	Yes	Yes	Yes
Default placement	[1]	Yes	No
Manual placement	Yes	No	Yes
Menu-processing function	Yes	Yes	Yes
Check marks	No	No	Yes
Separators/blank items	No	No	Yes
Unavailable items	No	No	Yes

[1] For secondary-level menus only.

Data-Entry Forms

The three packages take different approaches to defining data-entry forms, which are displays that prompt the user for data. C-Worthy and Windows for Data treat forms much like they treat menus: First you define the form, and then you add fields and text strings to it. Finally, you call a function that handles the user's interaction with the form and stores the response. The form is stored as a linked list in both packages.

Vitamin C doesn't have data-entry forms; instead, it defines a set of fields and their relative placement within the current window. The `atsayget()` function positions the cursor, prints the prompt string, and sets up the data-entry field. All input fields are placed in a "get table." The function `readgets()` controls all user input based on the entries in the get table, and then deletes all entries from the table when data entry is finished.

You must specify the form's coordinates in Windows for Data when the form is defined. Next, you specify the location of every field. You can define the prompt and the field in one call, and the field is automatically placed next to the prompt. However, you can corrupt memory if the placement of the fields is not consistent with the size of the form. This is an easy mistake to make, as the form size must be

continued

When Zenith Invented The Perfect Monitor The Industry Took A Giant Leap.

In the harsh light of day, no other monitor compares with Zenith's Perfect Monitor. The breakthrough of flat technology has redefined the monitor industry forever. The Perfect Monitor will redefine your expectations with one look.

50% brighter. Vastly enhanced contrast. Colors, richness and highlights that leap off the perfectly flat screen. Eyestrain and glare are virtually unheard of.

Backward and Forward Compatibility. The Perfect Monitor is compatible with IBM's new Personal System/2® computers. And with Zenith's Z-449 Video Card, it accommodates Zenith PC's...plus other AT and XT compatible PC's.

FREE...the Perfect Monitor Comparison Kit. To preview Zenith's new perfect monitor, send for your FREE Kit,* which includes a viewfinder and 4-color slides.

Or if you can't wait, call today:

1-800-553-0305.

*Offer expires 12/31/87.

Personal System/2 is registered trademark of IBM Corp.

ZENITH | data systems

THE QUALITY GOES IN BEFORE THE NAME GOES ON®

somewhat larger when you are using borders. For this reason, it's important to use the debugger during the development of data forms, because it catches this type of error at run time. Some help is available from the Forms Design utility, a simple program that lets you design forms by drawing them with a text editor.

In C-Worthy you must specify the lo-

continued

Table 2: *Data forms and field options for the three packages. I have used Windows for Data's terminology.* Autoexit *ends form processing after the last field is entered. For* Automove, *the cursor is automatically advanced to the next field when the current field is full. Normally the user must enter data by filling the fields in the order they are presented on the screen.* Cursorfree *lets the user enter data by moving the cursor to any field in any order.* Noecho *fields do not echo data to the screen.* Initialblanks *initializes all data-entry fields to display blanks before data is entered. The* clear *attribute clears the input field when the first printable character is entered. If a field is* required, *then some data must be entered in the field; if it is a* mustfill *field, then the entire field must be filled. A* picskip *field strips all formatting characters before returning the variable: For example, a phone number entered as (517) 353-9297 would be returned as 5173539297. Data in a* protected *field cannot be changed. The* skip *attribute means the cursor is never placed on the field. Data in a* rtadjust *or* lftadjust *field is right-justified or left-justified upon exit. A* rtentry *field lets a user enter numbers from right to left, as on a banking machine.* Trailblanks *specifies that blanks at the end of the string are to be retained as data.*

Forms and Fields	Windows for Data	C-Worthy	Vitamin C
Picture clauses	Yes	Yes	Yes
Predefined types			
string	Yes	[1]	Yes
extended string	Yes	Yes	No
date	Yes	Yes	Yes
time	Yes	Yes	No
Boolean	Yes	Yes	No
integer	Yes	Yes	Yes
longint	Yes	Yes	No
fixed-point	Yes	Yes	No
float	No	No	No
double	Yes	Yes	Yes
scientific notation	Yes	No	No
multiple choice	Yes	Yes	Yes
text edit	No	Yes	No
menu field	No	Yes	No
Form attributes			
user-defined validation	Yes	Yes	Yes
user-defined evaluation	Yes	Yes	Yes
user-defined control	Yes	Yes	No
Field attributes			
autoexit	Yes	Yes	Yes
automove	Yes	No	Yes
cursorfree	Yes	Yes	No
noecho	Yes	No	No
initialblanks	Yes	No	No
clear	Yes	Yes	Yes
required	Yes	Yes	Yes
mustfill	Yes	No	No
picskip	Yes	Yes	No
protected	Yes	Yes	No
skip	Yes	Yes	No
rtadjust/lftadjust	Yes	Yes	No
rtentry	Yes	Yes	Yes
trailblanks	Yes	No	Yes

[1] All string processing is extended-string processing.

Who says you need hardware to speed up your PC?

Personal computers, like automobiles and yachts, are much more rewarding when they're operating at high speed.

And, as with cars and boats, there's more than one way to get your PC moving.

You can, for example, buy an expensive piece of hardware with "turbo" or "accelerator" in its name.

Or you can buy an affordable piece of software with "Norton" in its name.

Because the same Peter Norton who brought you the indispensable Norton Utilities™ now brings you the Norton Commander.™

And what is the Norton Commander?

It's a power user's PC control program that lets you cruise through your data with the greatest of ease.

While taking the hard work out of working with a hard disk.

Directory assistance.

With the Norton Commander at your command, you can see your way through a sea of data faster than you can say "point and shoot."

A compact pair of pop-up directory windows put your files—and a fleet of file management functions—at your fingertips.

You can list your files any way you like them—by name, extension, size or date.

You can scroll through them or page through them.

Or use the special speed-search command to find them even faster.

You can also inspect, edit, move, rename, delete, copy and whip your files into shape—at the stroke of a key or the nudge of a mouse.

Automatic pilot.

Running your programs is a breeze. Especially when you take advantage of our custom user menus.

Or, if you want to take a convenient short cut, just point to your *data* and fire away.

The Norton Commander will find and run the matching program. Automatically.

How much memory does it take to work all of these wonders?

As little as 10K.

So it's no wonder the *Infoworld* Review Board found the Norton Commander so memorable.

"Tops in its class," they said. "Loaded with useful features" that provide "a new level of convenience for MS/DOS users." "The more we used it, the more we liked it."

You will, too.

Unless, of course, you'd rather not operate in the fast lane.

Peter Norton
COMPUTING

Designed for the IBM® PC, PC-AT and DOS compatibles. Available at most software dealers, or direct from Peter Norton Computing, Inc., 2210 Wilshire Blvd. #186, Santa Monica, CA 90403. To order, call 213-453-2361 (VISA and MasterCard welcome). MCI Mail: PNCI. Fax 213-453-6398. ©1987 Peter Norton Computing.

Circle 214 on Reader Service Card (Dealers: 215)

Name	Windows for Data version 2.05/ Windows for C version 4.12	C-Worthy Library version 1.0	Vitamin C version 3.0
Type	Screen utilities	Screen utilities	Screen utilities
Company	Vermont Creative Software 21 Elm Ave. Richford, VT 05746 (802) 848-7738	Solution Systems 541 Main St., Suite 410 South Weymouth, MA 02190 (617) 337-6963	Creative Programming Consultants P.O. Box 112097 Carrollton, TX 75011-2097 (214) 416-6447
Format	4 double-sided, double-density 5¼-inch floppy disks	5 double-sided, double-density 5¼-inch floppy disks	6 double-sided, double-density 5¼-inch floppy disks
Computer	IBM PC or compatible with at least 256K bytes of RAM	IBM PC or compatible or several noncompatible MS-DOS machines with at least 256K bytes of RAM	IBM PC and compatibles with at least 256K bytes of RAM
Hardware Required	Hard disk drive recommended	Hard disk drive	Hard disk drive
Software Required	Microsoft 4.0; Lattice 3.0 or higher; Aztec 3.40A or higher; Computer Innovations 2.3 or higher; Turbo C 1.0	Microsoft 3.0 or 4.0; Lattice 2.15 or 3.00; Aztec 3.4 or higher	Microsoft 4.0; Lattice 2.15 or 3.0; Aztec 3.20E; Computer Innovations 2.30; Datalight 3.0; Turbo C 1.0
Language	C	C	C
Documentation	426-page *Windows for C Reference Manual*; 428-page *Windows for Data Reference Manual*	485-page *C-Worthy Library*; documentation on disk	360-page *Vitamin C User's Guide/Reference Manual/Tutorial*
Price	$395 for Windows for Data and Windows for C; network for up to five users, $1185; with source code, $1290; free demo disk available	$295; with source code, $495; free demo disk available	$225 with source code

cation for both the prompt and the field. This doubles the number of function calls needed to define an average form, and you must modify the field placement any time the text of the prompt is changed. The text in the prompt string, like text in menus, is defined within a message librarian, which defines a symbolic constant used in your program whenever you wish to invoke the text. This allows text messages to be changed without recompiling the main program, and it makes it much easier to change the text to different languages. Unfortunately, this means that the actual text of the message is not visible when you are writing the calls to define the form, making it difficult to place the field properly. Table 2 lists the most important field-entry features of the three programs.

User-defined input functions allow your program to accept input in formats that you define yourself. This is convenient if the library's input format doesn't suit your data-entry needs. There are a number of ways to process form data fields, but generally they can be classified as control options, validation options, and evaluation options.

An example of a control option is a picture clause. A picture clause uses a control string that specifies what characters can occupy a given position in the field. For instance, if the digit 9 in the control string means that only a digit can be entered in the position, then the picture clause 99/99/99 allows pairs of digits to be entered between slashes for entering a date.

Validation functions specify what type of input is considered valid. The picture-clause example given for dates does not force you to enter a valid date: You could enter 89/88/00. A validation function corrects this type of data-entry error.

Evaluation functions determine what value should be stored in the data variable based on the validated contents of the input field. As an example of this, none of the packages accept fractions as floating-point numbers. However, one user might enter the value 0.5 in decimal notation, and another user might enter the value as a fraction (½). If you can define a data type that allows the use of either format, you can avoid forcing the user to convert values from one form to the other.

C programmers will recognize most of the types in table 2, but a few deserve special mention. Extended strings are strings that can include any extended ASCII character, which is useful when processing foreign language input. Multiple-choice fields present a list of options from which the user chooses. Text-edit fields call up a text editor and allow simple word processing in a window. The final results are returned to the program as a string.

Windows for Data supports significantly more form and field attributes than the others, and it supports all the predefined types except float, text-edit fields, and menu fields. C-Worthy provides extensive support for predefined types, and the text-edit field is useful when trying to make your data-entry forms fit on the screen. Defining forms is awkward, however. Vitamin C is relatively poor in features, but the syntax for defining forms is simple and intuitive. The programmer can add most of the missing features through programmer-defined routines that can be associated with the fields.

Additional Features

The context-sensitive help facilities of the three programs are similar. Windows for

Data and Vitamin C place all help messages in a file, where they are indexed on a keyword. Special characters indicate the keywords, and all text between keywords is assumed to be a help screen. Keywords are specified when defining menus, items, forms, and fields, and are used to access the relevant help text.

Windows for Data provides a function that reads the help file into memory so the program can use it; Vitamin C provides a utility that indexes the help file so it can be accessed efficiently. C-Worthy has a special utility, called the help librarian, that is used to define help text for the application. All three packages allow help text to be defined and implemented quickly and painlessly.

C-Worthy and Vitamin C both include simple text editors that you can incorporate into your programs. This can be extremely useful in programs that accept free-form text input: You simply define a window and call the editor. They have a good set of basic features: Both provide general cursor-positioning functions, word wrap, and cutting and pasting. Vitamin C also has a search function.

Strengths and Weaknesses

All three packages are suitable for professional programming and for the overall design of user interfaces. You will become more productive using any one of these programs, and I did not find one to be clearly superior to the others. Your taste and needs will be important factors in choosing a package. Demonstration disks are available separately for C-Worthy and Windows for Data, and I encourage you to obtain them if you want to evaluate these products. Vitamin C is available on a 30-day trial basis.

Windows for Data gets high marks for flexibility in forms, and it is good at menus (although not quite as flexible as Vitamin C). Windows for C provides extensive windowing facilities that can give your application a professional look. Windows for Data has a rich set of routines that will not restrict you if you know how you want your screens to appear.

Vitamin C provides the most options for menus. Macintosh fans will be pleased with its ability to duplicate the menus found on that machine. It would be more difficult to implement Macintosh-style menus with the other packages. Vitamin C is fairly weak in handling forms, as it provides only a few field types and relatively few field options, but the form-handling functions are easy to use and will be familiar to dBASE programmers. If you want source code, Vitamin C is the least expensive, and it is probably adequate for most users.

C-Worthy does not have as many options as the other packages, but its predefined menu styles allow development of attractive applications with less effort than the others. C-Worthy's screens are quite striking, and I found myself imitating them when working with the other packages. However, C-Worthy is good only as long as you stay within its predefined formats. If you want high-level support for a variety of custom menus, C-Worthy will not be of help. On the other hand, if you intend to translate your program for use with foreign languages, you will appreciate the fact that in C-Worthy, all text is managed by the librarians and can be changed without modifying the program. ■

Advantage C++ and Guidelines C++

by Mark Mallett

Advantage C++ and Guidelines C++ are two of the first PC implementations derived from the AT&T C++ translator developed by Bjarne Stroustrup.

C++ is a strict superset of C that adds facilities for data abstraction, in-line functions, and function prototyping. In-line functions let you avoid the overhead of procedure calls. Function prototyping ensures that procedures are used the same way they are declared.

The new features in C++ mainly support classes that give you the ability to define new data types and operators or to redefine already-existing operators (operator overloading). A class is a description of data. It can include how the data is stored, as well as how, or even whether, the data can be accessed. A class can be derived from another class (base), in which case it inherits some or all of the properties of the base class.

Advantage C++ version 1.1M3 (Lifeboat Associates, $495) and Guidelines C++ version 1.1 (Guidelines Software, $195) each require an IBM PC, XT, AT, or compatible. A hard disk drive and 640K bytes of RAM are recommended.

C++ compilers are often referred to as translators because they produce C code, not assembly language or binary output. Thus, you must also have a C compiler. Advantage C++ works with either the Lattice compiler (version 3.0 or higher) or Microsoft C (version 3.0 or higher); Guidelines C++ requires Microsoft C (again, version 3.0 or higher).

For this review, I used an Intelligent Micro Systems PC AT–compatible computer running at 10 megahertz, with 3.5 megabytes of RAM and a 42-megabyte MiniScribe 28-microsecond hard disk drive. I used Microsoft C version 4.0, with MS-DOS 3.1.

The main differences between these two implementations are in the documentation, the front end, and the price. I did not find any significant differences between the libraries supplied.

Starting Up

The bulk of the documentation for both packages consists of Stroustrup's book, *The C++ Programming Language* (Addison-Wesley, 1986). Advantage C++ comes with a bookshelf-style box and binder, with some excerpts from AT&T release notes, a small amount of introductory material from Lifeboat, and some discussion of future packaging plans. A small, nicely printed user's guide is also included, but it doesn't say much that isn't said in Stroustrup's book. Guidelines C++ documentation consists of essentially the same AT&T release notes, bound in a full-size three-ring binder. The print quality leaves much to be desired; most of the pages are poor-quality photocopies.

Installing either package is amazingly painless. For each, you insert the first of two disks and type `install` with the appropriate parameters, and after awhile you insert the second disk and hit Return. After that, you may have to do some minor tinkering to set environment variables that C++ uses to find directories.

One complaint that I have is that, unless you specify otherwise, the Advantage installation program puts some of its files (executables and include files) into the directories used by the C compiler (Microsoft's, in my case). I prefer to keep different packages totally separate. Another complaint is that, to avoid name conflicts with the C compiler's files, Advantage gives some of its include files the extension .HXX. I'd rather have standard include-file extensions, so source files

continued

Advantage C++ version 1.1M3

Type
Translator

Company
Lifeboat Associates
55 South Broadway
Tarrytown, NY 10591
(800) 847-7078
(914) 332-1875

Hardware Required
IBM PC, XT, AT or compatible with at least 640K bytes of memory (a hard disk drive is recommended); MS-DOS 2.0 or higher; either Microsoft C version 3.0 or higher, or Lattice C version 3.0 or higher

Language
C++

Documentation
Bookshelf-style binder with loose-leaf user's guide, release notes, and *The C++ Programming Language* by Bjarne Stroustrup

Price
$495

Guidelines C++ version 1.1

Type
Translator

Company
Guidelines Software
P.O. Box 749
Orinda, CA 94563
(415) 254-9393

Hardware Required
IBM PC, XT, AT, or compatible with at least 640K bytes of RAM (a hard disk drive is recommended); MS-DOS 2.0 or higher; Microsoft C version 3.0 or higher

Language
C++

Documentation
Full-size three-ring binder with photocopied installation guide, reference sheets, and release notes; *The C++ Programming Language* by Bjarne Stroustrup

Price
$195

don't have to be modified depending on the compiler being used.

These complaints, however, are subjective, minor, and solvable. The installation program lets you specify another directory during installation. Then you can rename all the .HXX files, giving them .H extensions, provided that you keep them in a separate directory from the C compiler's include files.

Translating and Compiling

Both products follow similar steps in turning C++ source programs into executable files. First, the program is run through the C++ preprocessor. This is similar in function to the C preprocessor, removing comments from the source file and handling directives that begin with a #, and providing for insertion of include files, macro definition, and expansion. The output from the C++ preprocessor goes to the C++ compiler itself, which compiles it into C language source code; this is then run through the C compiler. A linker combines the code from one or more relocatable files, along with routines from any run-time libraries used (including, at least, the standard routines supporting the C++ product and the C product used), and produces an executable program.

To control the compilation process, Guidelines provides an array of batch files. For each memory model (small, compact, medium, large, and huge), there are four batch files, each of which takes a C++ source file to a particular stage in the compilation. One batch file runs the source file through the C++ preprocessor; another preprocesses and translates to C source code; a third does these first two steps and also compiles the C source code; and the last carries out the first three steps and then generates an executable file.

The batch files, which are all hidden away in a subdirectory, are named in a way that makes it easy to remember what the names are. You can reference these batch files from a MAKE file; Microsoft's MAKE utility had no trouble with them. Also, the Guidelines documentation includes complete descriptions of how to run each phase of the C++ compiler, in case what you want to do isn't covered in any of the batch files.

Advantage C++ supports small, compact, medium, and large model programs. Instead of batch files, Advantage C++ provides a driver program that automates the compilation program. This program directs the process by invoking the C++ preprocessor and compiler, the C compiler, and, finally, the linker. Parameters to this driver program can specify various options, such as how much of the compilation process to perform, or whether to allow old-style function definitions in order to compile plain C code. These options are given on the command line as a special character, such as a minus sign or an exclamation point, followed by an alphabetic character that identifies the option.

One of the options to this driver program causes it to output the commands that it would execute, without actually executing those commands. You can use this option to build a batch file to be executed later. This is useful when you don't have enough memory to run both the compiler and the driver program plus any program that may be controlling it; in fact, with the programs I compiled, this technique was necessary when using Advantage C++ with Microsoft's MAKE utility.

The command syntax for the driver program is completely documented, but Lifeboat should include specific documentation for the individual compiler phases. The only way to learn the command syntax is to vary the parameters to the driver program, run the program, and output the results to a batch file. Then you must look at the commands that it generates and find the relationship between the options you typed and the command lines it generated.

Debugging C++ Programs

With either product, you can debug the C++ source files with Microsoft's Codeview debugger. Both products ran into problems with Codeview when non-in-line functions were defined in include files. With Advantage, Codeview will not enter into the include file; with Guidelines, it gets stuck in the include file. The Advantage documentation notes this as a flaw in Codeview.

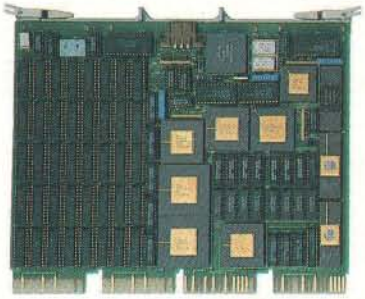
Within Codeview, you must reference variables by their names as output by the C++ compiler, even though the C++ variable names are shown in the source window. Both packages use the same rules for forming these names, and although the names are long and hard to type, the rules for constructing them are easy to figure out. For example, a structure variable called `str1` has a member `mem1`, declared as an integer. If the variable `str1` is on the stack, member `mem1` would be referred to by the name `_auto_str1._INT_mem1:`. The storage class is attached to the beginning of the variable or member name, with underscores in front of each class, variable, and member name.

Messages from the C++ compilers are peculiar at times (especially when inserting in-line functions, from which a lot of `Sorry, not implemented` messages can result), but both products' messages are peculiar in the same ways. In fact, I got both C++ compilers to give me an `Internal error` message.

Both compilers have a habit of generat-

continued

Introducing A High-Performance Graphics Engine With A Low Sticker Price.



Now the DEC MicroVAX II® can be equipped with "four-on-the-floor."

Here's a high-performance champion that's graphically superior.

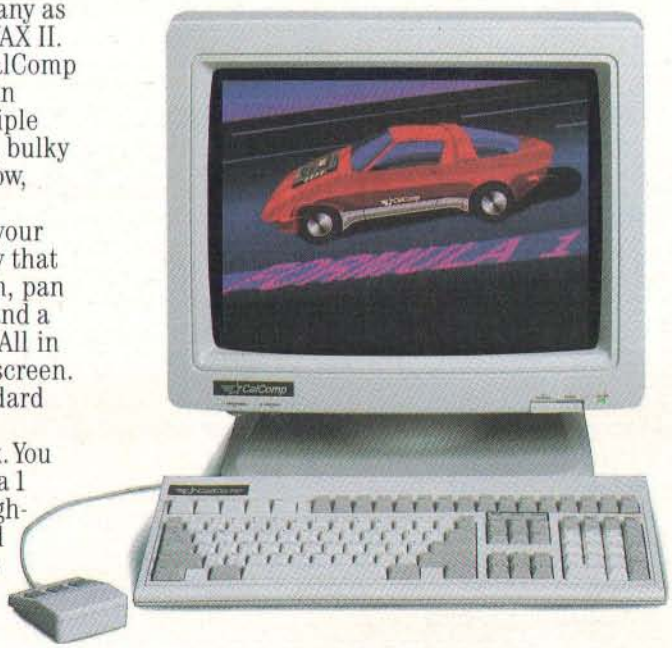
It's CalComp's new Formula 1™ Series. The hot little graphics engine that uses new, custom VLSI gate-array technology to give you as many as four workstations from a single MicroVAX II. Without excess power drain. Before CalComp got in the race, a MicroVAX II could gain graphics capability only by using multiple slots. Or with the addition of separate, bulky and expensive controller hardware. Now, there's no contest.

With CalComp's Formula 1 Series your MicroVAX II gains a graphics capability that will set the designing mind free. Zoom, pan and update with turbocharged speed and a high-visibility 1280 x 1024 resolution. All in 256 souped up colors on a flicker-free screen. Plus get 32-bit floating point CGI standard functionality as standard equipment.

And don't worry about sticker shock. You can drive away with the entire Formula 1 Series subsystem—graphics engine, high-resolution color monitor, keyboard and mouse—for only $6995. Or, try-out the Formula 1 Series engine alone for just $3995. It's your option.

Naturally, our smooth-running Formula 1 Series graphics engine is **CalComp**atible with other peripherals and software. For information and specifications call 1-800-CALCOMP. Or write CalComp, P.O. Box 3250, Anaheim, CA 92803.

Drop the Formula 1 Series graphics engine into your MicroVAX II and see what it'll do. Because there's no other way to get high performance and four-on-the-floor at a price like this.



We draw on your imagination.™

CalComp
A Lockheed Company

DEC and MICROVAX II are registered trademarks of Digital Equipment Corporation.
Formula 1 is a trademark of CalComp. © 1987 CALCOMP

Circle 318 on Reader Service Card (Dealers: 319)

Table 1: *Operator overloading tests. In this test, I used C++ operator-overloading techniques to change the way basic arithmetic and logical functions were compiled using the BYTE Sieve program without changing the source of the Sieve program itself. "Unmodified" indicates the Sieve program without changes. "In-line substitution" redefines all arithmetic and logical operators, but does so using in-line operator procedures. "External substitution" reimplements all operators by using procedure calls. "External, no registers" is the same as "External substitution," except that the operator functions do not declare their terms to be of class "register."*

	Compile time (in seconds)	Execution time (in seconds)	File size (in bytes)
Unmodified			
Advantage	16	22	8048
Guidelines	15	22	6824
In-line substitution			
Advantage	19	24	8080
Guidelines	18	24	6852
External substitution			
Advantage	21	222	8464
Guidelines	20	224	7220
External substitution, no register			
Advantage	21	217	8448
Guidelines	20	217	7204

ing very long symbol names. This often causes the Microsoft C compiler to issue messages warning that the symbol names have been truncated to the first 32 significant characters. Error messages from the C++ compiler itself (again, both products) do not necessarily refer to source-file lines in order; and although they are usually quite accurate (my favorite was `Perhaps you forgot a ';' after the '}'?`), occasionally error messages have nothing at all to do with the problem.

Finally, both C++ compilers emit spurious unreferenced values in the C code, from null constructors and destructors. Since these are unnecessary, the C compiler filters them out.

Benchmarks

I modified the standard BYTE Sieve benchmark to perform 100 iterations rather than 10. (On my AT, 10 iterations were too fast to measure easily.) I then compiled and ran the benchmarks under both C++ products and compared the results to compiling and running under Microsoft C. Not surprisingly, there is very little difference in code size or execution speed between the two C++ packages. Both packages produce slightly larger executable files than does the Microsoft C compiler by itself; this is to be expected, because of extra start-up and termination code with C++.

One important aspect of type definition is operator overloading—using standard operators, such as + and <, to manipulate variables of user-defined data types. To investigate the performance of operator overloading, I redefined the operators in the Sieve program and compared this to the same program using built-in operators. I chose the Sieve program because, while it makes heavy use of integer arithmetic and Boolean operations, it uses only a small number of different operators. To overload operators, you write C++ procedures to implement each operator.

Taking a cue from one of the exercises in Stroustrup's book, I created a file to be included at the beginning of the Sieve program. This include file defines a class INT, to be equivalent to an `int`, and the appropriate operators for it. Class `INT` looks like this:

```
class INT {
  int val;
public:
  INT( int i ) { val = i; }
  INT() {}
  int operator= (int t2);
  int operator+ (int t2);
  int operator- (int t2);
  int operator+= (int t2);
  int operator++ ();
  int operator<= (int t2);
  operator int(); };
```

This definition defines a class `INT` that contains a single integer value and overloads some arithmetic and Boolean operators. I've also defined a way to convert from class `INT` to type `int`, so that binary operations on two `INT` types will also work. The bodies of all the operator functions are declared apart from the definition of the `INT` class, to make it easier to change them from in-line to non-in-line for this test.

I ran this benchmark in three ways: with the operator functions declared in-line, not declared in-line (external substitution), and not declared in-line but also with their second term not declared as a register variable. (The first term of a binary operator is always declared as a register variable.)

Table 1 gives the compilation time, execution time, and executable file size for each scenario with each C++ system. In this test, the use of in-line procedure substitution cost little in execution time over the original benchmark (24 seconds versus 22 seconds for both products), nor was there a significant increase in file size. The penalty in execution time when in-line substitution was not used is not surprising: The added function-call overhead slowed the execution of the program by a factor of 10 (222 seconds for Advantage and 224 seconds for Guidelines, as opposed to 22 seconds for the base non-overloaded-operator version for both products). Note that when the second operator was not declared as a register variable, the execution time improved slightly. This is also normal behavior in C programs; declaring a little-used variable as a register variable often costs more time to set up the register variable than it saves in accessing the data through a register.

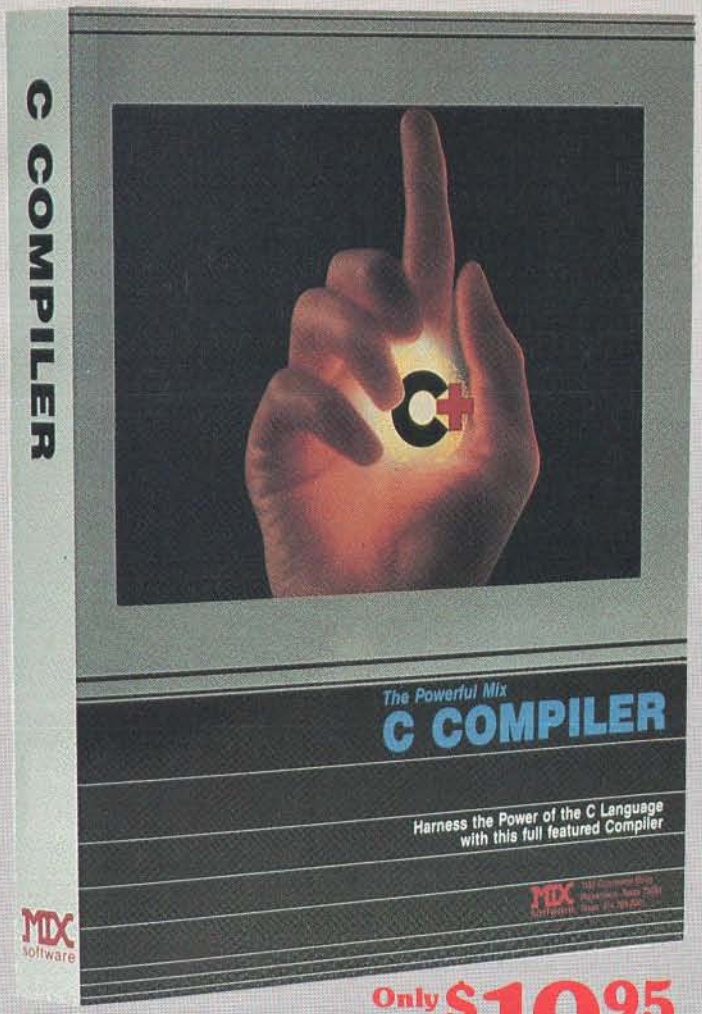
Operator overloading works well and efficiently in both packages. The benefits of operator overloading, and other aspects of data abstraction, include clearer semantics and more reliable code, resulting from the separation of datatype definition and data use. Where operators can be implemented in small functions with in-line substitution, there is very little increase in size or execution time. Where in-line substitution is not used, you must bear the overhead of procedure calls; but keep in mind that implementing the equivalent operations in C involves function calls that must be coded explicitly.

I wrote a more extensive program, called Score, which uses the unique features of C++ to manipulate simple representations of melodies to test the unique features of C++. All song elements are derivatives of a base class, SCORE_ITEM. This program also defines input and output operators for each song element, to test overloading existing operators

continued

Back To School Special - Save Over 50%

Prices good through October 31.



C for yourself

Get off to a fast start with MIX C. Our comprehensive book and nimble C compiler will have you programming in C before you know it.

Our book is your teacher. You'll start right away, compiling and executing C programs. The tutorial takes you step by step through the C language. You'll learn by example with a book that's chock-full of sample programs. And the programs aren't just fluff. They teach you the important C concepts. An amortization program teaches you how to use pointers to functions. A data base program teaches you how to manage memory dynamically. It's the best hands on training available.

You'll love working with our C compiler. It's half as large and twice as fast as other C compilers. In fact, it's the only full featured C compiler that can be operated comfortably on floppy disks. And as you would expect, MIX C is easy to use. It produces a complete program listing with compile errors clearly identified and explained. If you've been frustrated by other C compilers, don't throw in the towel until you've tried ours. There's a big difference.

*Although it's small, MIX C is not a subset. MIX C supports the full K&R standard, including the extensions that are often omitted in other C compilers. MIX C comes complete with a comprehensive book, a standard library of more than 175 functions, a blazingly fast linker, and tools for optimizing your programs for minimal space or maximum speed. All of this is yours for the incredibly low price of **$19.95**. That's little more than the cost of most C books alone. So don't be left behind. Order your copy today and find out why everyone is switching to C.*

TO ORDER CALL TOLL FREE: 1-800-523-9520

For technical support and for orders inside Texas please call (214) 783-6001 Or Contact one of our Distributors in Canada: Saraguay 1-800-387-1288 • France: Info/Tech 1-43-44-06-48 • Australia: Techflow 047-586924 • Switzerland: DMB Communication CH-0-523-31817 • England: Analytical **0703-262099**

System Requirements: MSDOS/PCDOS 2.0 or higher; 256K Memory; 1 Disk Drive or CP/M 2.2 or higher (Z80); 55K Memory; 1 Disk Drive (2 recommended) (Ctrace not available for CP/M)

Only $19.95

CTRACE DEBUGGER $19.95

The perfect companion for MIX C is our exciting new C source debugger. Ctrace is unlike any debugger you've ever seen. It brings your programs to life on the screen. You'll see your variable values changing as you watch your C source code executing. The animated trace shows you the flow of execution, statement by statement. It's like watching the bouncing ball as the cursor dances over your C program.

Ctrace is very simple to operate. Commands are executed with a single keystroke. Pop up menus list the command options. Pop up messages alert you when anything important happens. There are 6 windows of information: source, output, variables, watch, memory, and symbols. You can view as many as 4 windows at once. The function keys make it easy to quickly choose among 8 different views.

The combination of Ctrace with MIX C makes C programming a real joy. MIX C provides the power of a compiler while Ctrace provides an execution environment that's more elegant than an interpreter.

SPLIT-SCREEN EDITOR $19.95

Another great companion to the MIX C compiler is our split-screen editor. It makes writing programs even faster and easier. With the MIX Editor, you can compile, link, and execute your program at the touch of a key. Compiling is fast because the MIX C compiler reads the program directly from memory. Correcting errors is easy because the editor automatically positions the cursor to the first error in the program. The editor is similar to Micropro's WordStar but with additional programming features like split-screen, macros, and much more. Use it for all your programming needs.

ASM UTILITY $10.00

Our ASM utility is available if you want to link assembly language functions to your C programs. It works with Microsoft's MASM or M80 assemblers. Call assembly language functions just like C functions. Call C functions from assembly language. Lots of useful assembly language functions are included as examples.

Save $29.95 on the Works includes Editor, C Compiler, Ctrace, & ASM Utility

Product	Price	Total
_Ctrace	($19.95)	$ _____
_C Compiler	($19.95)	$ _____
_ASM Utility	($10.00)	$ _____
_Split-Screen Editor	($19.95)	$ _____
_The MIX C Works (includes all of above)	($39.90)	$ _____
Subtotal		$ _____
Texas Residents Add 7.25% Sales Tax		$ _____
Add Shipping Charges		$ _____

In USA: add $5 per order
In Canada: add $10 per order
Overseas: add $10 for editor
add $20 for compiler
add $30 for Works

Total of Your Order . . . . $ _____

30 Day Money Back Guarantee
Not Copy Protected

Please check method of payment
__Check __Money Order __MC/VISA
Card # _____
Expiration Date _____
Please give name of computer
_____
Please check operating system
__ MSDOS/PCDOS __ CP/M
Please check disk size
__ 5¼" __ 3½" __ 8"
Please check disk format if CP/M
__ SSSD __ SSDD __ DSDD
Your Name _____
Street _____
City _____
State _____ Zip _____
Telephone (_____) _____-_____
Country _____

MIX software
1132 Commerce Drive
Richardson, Tx 75081
(214) 783-6001

Ask about our volume discounts!
Dealer Inquiries Welcome

B

Circle 187 on Reader Service Card

on already-defined types when new types are defined. It lets the user enter song items (e.g., rests, notes, and chords) using stream I/O (a facility that is part of the C++ library), and then play back the song using a virtual function defined for all items.

Advantage C++ took somewhat longer to compile and link the program than did Guidelines (89.5 seconds versus 81.5), but the executable files that each product produced were nearly the same size: Advantage C++ produced a 31222-byte file, and Guidelines C++ produced a 30308-byte file. Since Score is an interactive program, execution times are not relevant. Both programs performed identically and as expected. [Editor's note: *The source code for Sieve and Score is available on disk, in print, and on BIX. See the insert card following page 304 for details. Listings are also available on BYTEnet. See page 4.*]

Little Difference

C++'s extensions to the C language promote more understandable, reliable, and maintainable programs by providing stronger type-checking (especially concerning procedure definitions and references) and support for data abstraction. Once you have decided that the C++ extensions to C are useful enough to learn, you will want to choose a commercial implementation.

I could find very little difference between the performances of Advantage C++ and Guidelines C++. Both are essentially equivalent in ease of use, execution time, and generated code. Advantage C++ has the edge in documentation, since it comes with many sample source files and all the examples from Stroustrup's book. If you want to use Lattice C, then your only choice is Advantage C++. If you are using Microsoft C, the difference in price ($195 for Guidelines, $495 for Advantage) recommends Guidelines. ■

[Editor's note: *At the time of this writing, Guidelines informed us that version 1.2 would be released this month. According to the company, it will include professionally printed documentation and more example programs on disk, and will cost $295. Lifeboat was also scheduled to come out with version 1.2 last month; according to the company, version 1.2 will have Microsoft Windows compatibility and improved documentation.*]

Mark Mallett is a 10-year computer veteran with interests in systems, graphics, database, mail, and conferencing software. He can be contacted at Zinn Computer Co. (Litchfield, NH 03103.)

Add up to 96K above 640K to all programs, including PARADOX and 1-2-3.

Parity-checked 256K with a one-year warranty.

Run custom software or the 3270 PC Control Program above 640K.

Run resident programs like Sidekick above 640K.

Top off a 512K IBM AT's memory to 640K and add another 128K beyond that.

Short card works in the IBM PC, XT, AT, and compatibles.

Add expanded memory to programs supporting the Lotus/Intel/ Microsoft specification 3.2.

MAXIT™ memory works above 640K for only $195.

Break through the 640K barrier.

MAXIT increases your PC's available memory beyond 640K. And it does it for only $195.

MAXIT includes a 256K half-size memory card that works above 640K. MAXIT will:

- Add up to 96K above 640K to all programs.
- Run memory resident programs above 640K.
- Top off an IBM AT's memory from 512K to 640K.
- Expand 1-2-3 Release 1A or 2.0 worksheet memory by up to 256K.
- Add expanded memory above 640K to programs like Symphony 1.1.

Big gain — no pain.

Extend the productive life of your, IBM PC, XT, AT or compatible. Build more complex spreadsheets and databases without upgrading your present software.

Installation is a snap.

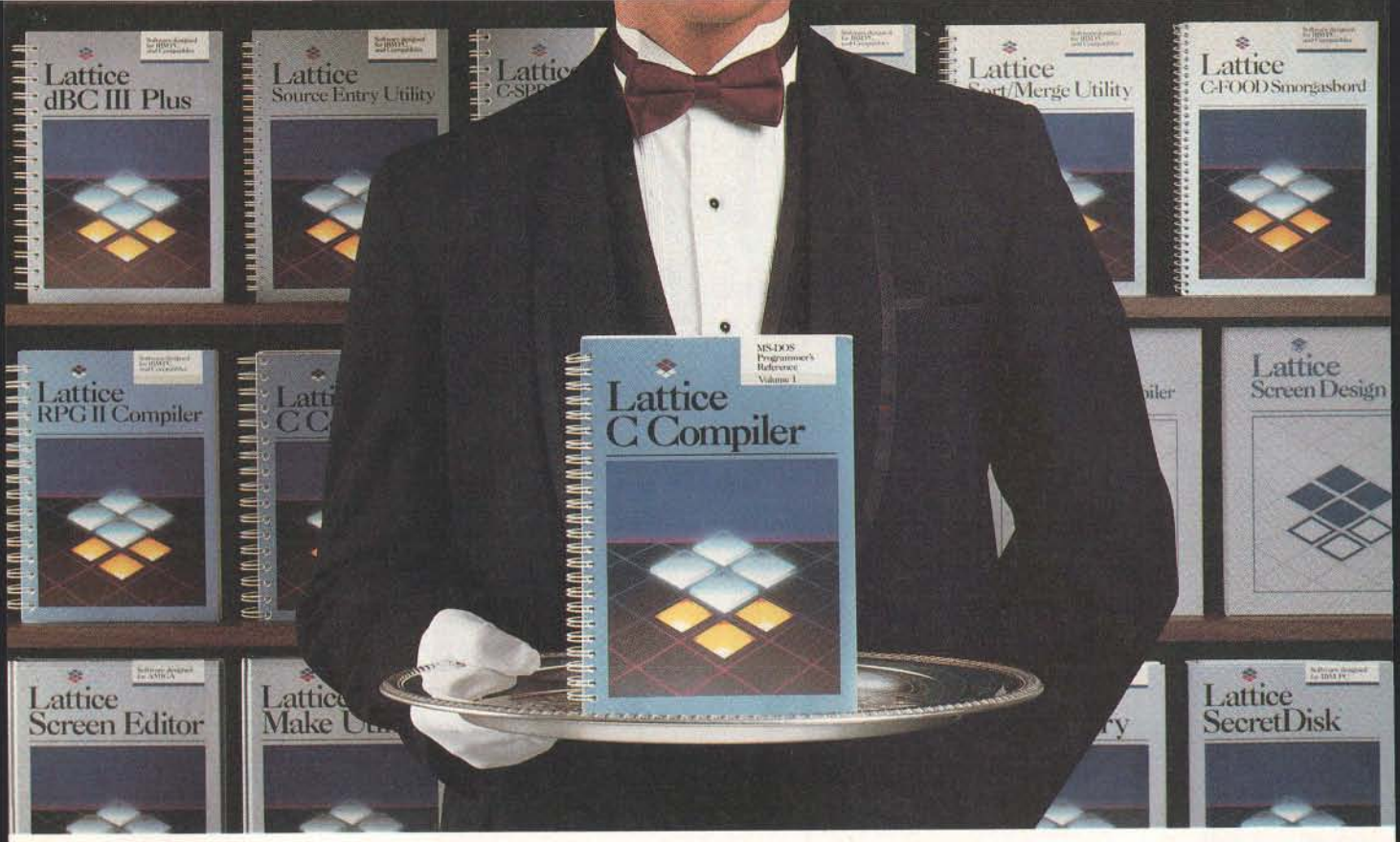
MAXIT works automatically. You don't have to learn a single new command.

If you have questions, our customer support people will answer them, fast. MAXIT is backed by a one-year warranty and a 30-day money-back guarantee.

Order toll free 1-800-227-0900.

MAXIT is just $195 plus $4 shipping, and applicable state sales tax. Buy MAXIT today and solve your PC's memory crisis. Call Toll free 1-800-227-0900 (In California 800-772-2531).
We accept VISA, MC, AE, and DC.

Osborne McGraw-Hill
2600 Tenth Street, Berkeley, California 94710



Our software comes with something no one else can offer.

Lattice Service.

When you join the Lattice family of customers, you'll discover that your software purchase is backed by more than just an excellent warranty. It's backed by unparalleled technical support. By a total commitment to your success and satisfaction. And by Lattice's dedication to excellence in products and services.

Unlike other software manufacturers who charge you for services after you've purchased their product, Lattice offers a unique package of support programs at a price we can all live with—FREE.

Lattice Bulletin Board Service
LBBS is our 24-hour a day bulletin board system that allows you to obtain notification of new releases, general information on Lattice products, and programs for the serious user. And if you've ever experienced the frustration of having to wait a year or more for a new release (that has corrected a bug), you'll really appreciate LBBS. Because with this service, you can actually download the latest program fixes to instantly eliminate any bugs discovered after release.

Technical Support Hotline
Responsible, dependable and capable Support Representatives are only a phone call away. You will talk to a highly skilled expert who is trained to answer any questions you have relating to specific Lattice products. Remember, your complete satisfaction is our goal.

McGraw-Hill BIX™ Network
The Byte Information Exchange (BIX) Network is a dial-in conference system that connects you with a Special Interest Group of Lattice users. The nominal one-time registration fee allows you to BIX-mail your questions—via your modem—directly to Lattice. Or you can post your questions in the conference mode for Lattice or other users to answer. Once again, you have 24-hour access.

You Also Receive:
▪ Timely updates and exciting enhancements ▪ 30-day, money-back guarantee ▪ Lattice Works Newsletter ▪ Technical Bulletins ▪ Access to Lattice User Groups

Lattice has developed more than 50 different Microcomputer software tools that are used by programmers worldwide. We were there for every MS-DOS release. We're there now for OS/2. And we'll be there for the next generation of technical changes. But most of all, Lattice is there for you.

Lattice

Lattice, Incorporated
2500 S. Highland Avenue
Lombard, IL 60148
Phone: 800/533-3577
In Illinois: 312/916-1600

Subsidiary of SAS Institute Inc.

Available through dealers and distributors worldwide.

Circle 147 on Reader Service Card

Equation Solvers

by George A. Stewart

Eureka and TK Solver Plus do mathematical computing without programming

Eureka and TK Solver Plus offer two very different approaches to equation solving on computers.

Eureka 1.0, a $167 MS-DOS package from Borland International, is easy to use and is a good educational tool for any field involving mathematics, but it is limited in its suitability to realistic mathematical applications. (For instance, equation files are limited to 20 variables, 20 equations, 10 user-defined functions, and 10 unit conversions.) The program's strongest technical feature is its nonlinear optimization.

TK Solver Plus 1.0, a $395 MS-DOS product from Universal Technical Systems, is a more sophisticated, open-ended product that can solve realistically sized models in engineering, finance, pure math, statistics, chemistry, and other mathematical fields. Some of its more interesting features are interactive display tables, user-defined procedures, input and output lists, list functions, a large-model capacity (>1000 equations, limited only by memory), and exceptional error-handling.

Eureka 1.0

Anyone familiar with Borland programming languages such as Turbo BASIC and Turbo Pascal will have an easy time learning Eureka; the pull-down menus, windowing controls, and editor are the same. Newcomers to Borland products shouldn't have much difficulty, either; the interface is simple and intuitive.

Instead of a programming-language source-code window, Eureka gives you an equation file window. The entire problem definition goes in that one window. ASCII-format equation files can also be loaded from and saved on disk. Other analogs to programming are the ability to set global parameters using commands in the equation file, and the ability to include other equation files implicitly with an `$INCLUDE` directive.

Copying the programming-language interface has its drawbacks, however. Most importantly, all the input values have to be provided in the program as equations or set as default values using a global switch setting. Also, you cannot easily obtain an orderly list of all variables in the model, one that clearly identifies the input and output variables.

To solve a set of equations, you exit from the edit window and activate the Solve command. Eureka first tries to obtain the solution directly, by reordering the equations and substituting constants. If the program makes six substitutions and still can't solve for all the unknowns, it begins an iterative process of making educated guesses.

After satisfying the equations, Eureka presents the results in a solution window. Each variable in the equation file is listed alongside its value. There is no indication as to which variables are constants and which were derived. After the variable list, Eureka gives additional information, such as the maximum error of the solution and warning messages.

Eureka has the very handy ability to constrain a solution. For instance, you may want to find a root of a previously defined function `f(x)` over a specified interval [−1,0]. You simply put the following into the solution file: `f(x)=0: -1 <= x <= 0`.

Equally powerful are the maximize and minimize directives. For instance, to find the maximum of `f(x)`, you use `$max(y)` and `y=f(x)`.

Eureka also plots functions that you define and presents a small text-mode graph. Pressing Alt-F5 generates a full-screen text-mode graph, and pressing F5 generates a graphics-mode graph (if a graphics adapter is installed). The text-mode graphs are surprisingly smooth, due to the clever use of three different characters for dots, effectively tripling the screen's vertical resolution.

Limitations of Eureka's graphing include the inability to plot more than one function on the same graph, and the absence of any grid marks or numbers except at the extreme points of the axes.

Eureka also has limited facilities for generating lists based on function evaluations. Given a function `f(x)`, the program generates a two-column table containing a list of values for `x` and `f(x)`. There is only one way to specify the values used for `x`: *start—increment—number of values.*

Eureka's reporting facilities are easy to use, but they are limited to the information developed in the screen windows. A pull-down menu lets you specify the output device (screen, printer, or disk file) for the report. The report contains the complete equation file, solution, and any graphs and lists that you generated. You cannot use it to generate more detailed tables or graphs. Additionally, you can set Eureka to keep a log file containing the results of various equation solutions.

Eureka has a context-sensitive on-line help utility. The help file is about 29K bytes of uncompressed text.

Eureka's 250-page user's manual gives a good operational view of the product. About 14 pages are devoted to modeling techniques—just a bare introduction to a very complex subject. The 100 pages of worked examples are very helpful. The worked examples are also included on the program disk.

TK Solver Plus 1.0

TK Solver Plus is a descendant of TK!Solver, introduced by Software Arts in 1983. Universal Technical Systems has

continued

George A. Stewart is a technical editor at BYTE. He can be contacted at One Phoenix Mill Lane, Peterborough, NH 03458.

Eureka version 1.0

Company
Borland International Inc.
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8400

Type
Equation solver

Format
One double-sided, double-density 5¼-inch floppy disk; not copy-protected

Computer
MS-DOS-based computer with 384K bytes of RAM and one floppy disk drive

Documentation
250-page user's manual

Price
$167

TK Solver Plus version 1.0

Company
Universal Technical Systems Inc.
1220 Rock St.
Rockford, IL 61101
(815) 963-2220

Type
Equation solver

Format
Six double-sided, double-density 5¼-inch floppy disks; not copy-protected

Computer
MS-DOS-based computer with 384K bytes of RAM and one floppy disk drive

Documentation
100-page tutorial; 200-page technical reference; 100-page application notes

Price
$395 for new users
$145 with trade-in of TK!Solver 1.6
$200 with trade-in of earlier versions

rewritten the code in C to improve speed and portability (the original program was written in a proprietary development language of Software Arts). [Editor's note: *For a review of TK!Solver, see the December 1984 BYTE.*]

The user interface of TK Solver Plus is based on the concept of sheets of information that keep a model organized: There are separate sheets for rules (i.e., equations), variables, lists, user-defined functions, procedures, units, lists, plots, tables, numeric formats, and global settings. TK displays either one full-screen sheet or two split-screen sheets.

TK stores models in an abbreviated ASCII format. It can also read in and write out list data in WKS (used by Lotus 1-2-3), DIF (used by numerous spreadsheet programs), and ASCII formats.

You begin a new model by entering equations into the rule sheet. As each rule is entered, any new variables that you introduce appear in the variable sheet.

The variable sheet lists all the variables in the rule sheet. A status indicator identifies them as inputs or outputs and gives their most recent values. Variables can be either single-valued or associated with lists of values. List variables are used in TK's very powerful table- and plot-generation facilities. Variables can also be given the Guess attribute, which allows TK to use a specified first guess or the variable's most recent output value as a first approximation. Unless a variable has the Guess attribute, TK will not try to approximate it.

Each variable is associated with a subsheet giving additional properties of the variable: status, first-guess value, associated list, input or output value, numeric format, display unit, calculation unit, and comments.

If none of the unknowns has the Guess attribute, TK will attempt to solve the model using direct substitution methods. If not enough variables are known, TK will stop and tell you so. If there are conflicts between the equations, again, TK will stop and tell you. On the other hand, if you activate the iterative solver by assigning guesses to one or more variables, TK will go ahead and try.

Lists make it easy to generate and save a related set of calculations for use in further calculations or for generating tables or graphs. For instance, given the equation `payment = loan * (rate/(1-(1+rate)^-term))`, you can set up `payment` as an output list, `rate` as an input list, and all the other variables as input variables. Next, you can assign a list of 32 values to `rate`, ranging from, say, 8 to 16 percent. You can then specify constants for `term` and `loan`. TK will solve the equation once for each value from the `rate` list, saving the corresponding payment in the `payment` list.

Then you can generate a table or graph showing the payment required for various rates. Other list variables can also be included in the table. To specify the details of the table or graph, you go to the corresponding sheet and fill in information regarding format and content.

TK's interactive table subsheets (one for each table defined) let you modify the contents of a table cell and solve for the other related table entries. It's like using a spreadsheet, except that you haven't had to carefully plan the formulas that govern the row and column relationships.

TK has three kinds of user-defined functions: rule, list, and procedure functions. Rule functions serve much the same purpose as functions do in Eureka, except that they can be defined in terms of local variables that have no effect on the rest of the model; rule functions can also be defined in nonstandard fashion.

List functions relate two lists, a domain and a range, using any of four mapping techniques. Table mapping associates the *i*th element of one list with the *i*th element of the other list.

Step mapping uses the intervals between items in the domain list. Given an argument, a step function finds the first interval containing the argument and returns the value associated with the lower bound of that interval. Linear and cubic mappings also use the intervals between domain elements, but they interpolate values using linear or cubic polynomial approximation.

Procedure functions allow the specification of functions that are, in effect, algorithmic solutions. For instance, one procedure function might calculate the greatest common factor of two inputs.

TK's reporting capabilities are limited. You can copy the contents of most sheets to the printer or to a disk file, but you cannot generate a complete, readable report of the model, containing all the field definitions within each sheet.

TK's on-line help is context-sensitive and comprehensive. The help file is over 200K bytes of uncompressed text. TK comes with a 100-page tutorial manual, a 200-page technical reference manual, a 100-page application notes manual, the program disk, and additional disks containing a library of over 100 models and 200 procedures. All the manuals are well-written, and, taken together, they make TK a very well documented tool.

Technical Comparisons

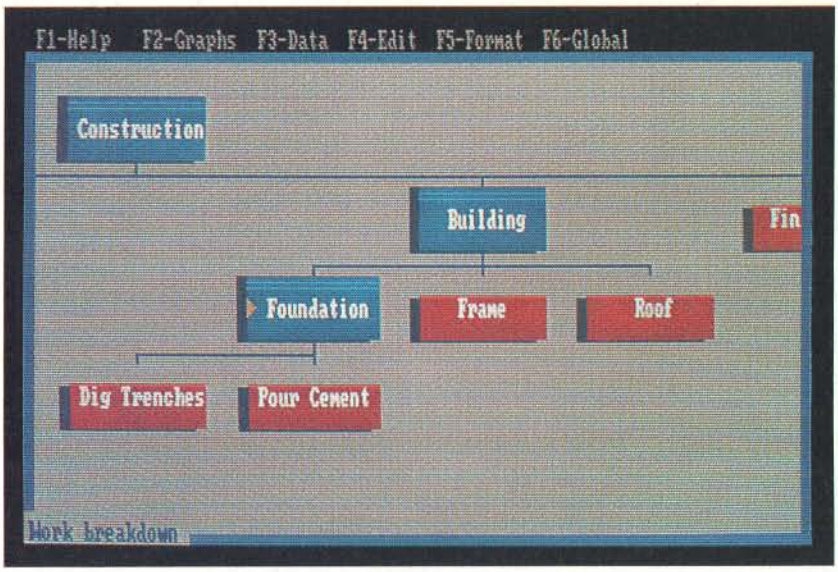
The one area where Eureka may have an advantage over TK is in optimization of nonlinear equations. Using Eureka, it is very simple to locate the roots of nonlinear functions, to find a minimum or maximum, or to satisfy other combinations of constraints. It is possible to do this with TK Solver Plus, but it's not quite so easy.

For instance, given a previously defined function `f(x)`, find the values of `x` that give the maximum values on the interval $[-\pi,0]$. In Eureka, you could use `$max(y)` and `y=f(x): -pi()<=x<=0`. You then activate the solver. If Eureka

continued

Is this the new look of project management?

Plan on it.



Our interactive Work Breakdown Structure is a more intuitive way to start planning.

We redesigned HTPM for a faster, easier approach to project management.

Even though Harvard Total Project Manager was the category leader, we knew we could make it better.

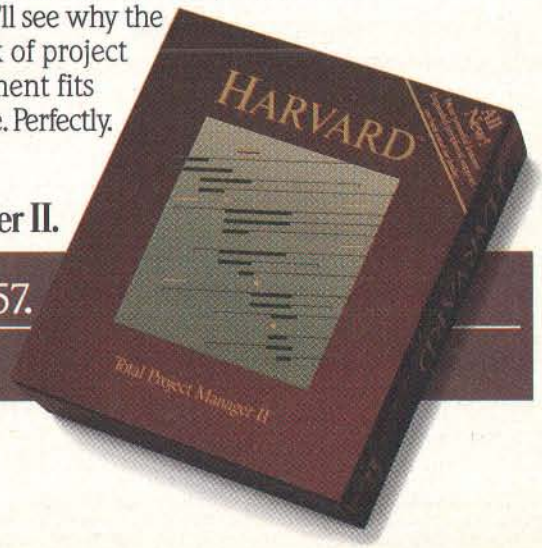
So we listened to project managers, added innovations, and created Harvard Total Project Manager II. The result is a redesigned project management tool that's dramatically easier to use, with more features and increased capability.

You'll see the difference right away. It starts with a more intuitive, easily accessible user interface. Then HTPM II's unique Work Breakdown Structure gives you the opportunity to plan your project completely on-screen. You also have the choice of other interactive planning formats: PERT charts, GANTT charts and Task Lists. Only HTPM II offers all four alternatives, letting you plan the way that works best for you.

HTPM II's other sophisticated features help you automatically track resources across multiple projects, add project data more efficiently, and keep everyone on the project up to speed with comprehensive presentation quality reporting.

We can't tell you everything about HTPM II here. We can invite you to call for our free trial disk, and find it all out for yourself.

You'll see why the new look of project management fits your style. Perfectly.



Graduate to Harvard Total Project Manager II.

For a free trial disk call 1-408-848-4391. Oper. #57.

For upgrade information call 1-800-255-5550.

Runs on IBM XT with hard drive and MS DOS compatibles. © Software Publishing Corporation, P.O. Box 7210, Mountain View, CA 94039-7210.

Circle 256 on Reader Service Card

finds a solution, you graph the function to see if other solutions exist on the interval. If they do, you adjust the constraint on x according to visual estimates from the graph.

In TK, after defining the function `f(x)`, you enter the rule `y = f(x)`. On the variable sheet, you make y an output-list variable and x an input-list variable. Fill the list x with, say, 50 values ranging from `-PI()` to 0, list-solve, and use TK's `MAX(y)` list function to find the largest value of y on the interval. You then input that value for y and back-solve for x. Even then, the maximum may not be exact: You've only broken down the interval into 50 subintervals. It might be better to now repeat the process over a smaller interval. Getting TK's best answer (maximum precision) takes some time. The proper way to solve this problem under TK is to use one of the optimizing procedures provided on the program disk.

Except for Eureka's built-in features for optimization and constraint problems, I found the two programs comparable in their iterative solving capabilities.

In some areas, TK is clearly superior. For instance, consider the following set of n simultaneous linear equations in $n+3$ variables:

$$a_1 = a_2 + a_3 - a_4$$
$$\ldots$$
$$a_n = a_{n+1} + a_{n+2} - a_{n+3}$$

I used these equations to test the solvers' back-solving capability by setting as inputs $a_1=1$, $a_2=2$, and $a_3=3$, and to test their reordering capacities by setting as inputs $a_{n+1} = n+1$, $a_{n+2} = n+2$, and $a_{n+3} = n+3$.

For $n=10$, Eureka took 72 seconds to back-solve. Setting the substitution level to 0 cut the solution time to 54 seconds. With the substitution level set back to 6, Eureka took 5 seconds to do the reordering test. TK took a split second to do both tests for $n=10$. (Tests were done on a 4.77-megahertz IBM PC with an Intel 8087 floating-point processor, which both packages fully support.) Eureka was unable to solve the equations by direct methods and had to resort to iterative methods.

In another test, I gave both solvers a set of eight linear equations in eight unknowns. Both solvers had to resort to iteration to produce a solution. TK took 6 seconds; Eureka took 77 seconds with substitution level 6, and 48 seconds with substitution level 0.

Automatic equation-solving is a deceptive area, and one must evaluate results carefully. Eureka is particularly liable to produce meaningless results. For instance, given the equation file `d=0: 8-b=8: 77/b=c/d`, Eureka came up with `b=0`, `d=0`, and `c=.99474364`. It also printed a warning that the solution process resulted in an attempted root or log of a negative number. This cryptic warning was not visible in the small solution window; I had to zoom to see it. Given the same set of equations, TK (correctly) refused to give any answer and printed an error message about division by 0.

The Real World

Most real-world mathematical models involve dozens of variables, functions, and equations. Eureka 1.0's stated limit of 20 variables, 10 user-defined functions, 20 equations, and so forth, makes it inapplicable to many real-world problems. On the other hand, the program is perfectly suitable for smaller, educational models, as evidenced in the sample models distributed with the program.

TK Solver Plus 1.0 is the obvious choice for someone who needs a mathematical tool for professional work in engineering, mathematics, finance, and other scientific fields. ■

continued

WELCOME TO COMPUSERVE.
THE LARGEST COMPUTER INFORMATION SERVICE IN THE UNIVERSE.
(AS FAR AS WE KNOW.)

More people use CompuServe than any other online computer information service on Earth.

Over 375,000 members access hundreds of information, communications and entertainment services online.

Thousands with similar interests and special expertise converge regularly and exchange ideas on an ever-expanding list of special-interest Forums.

They have access to a combination of more financial information, a greater variety of shopping services, and deeper research resources than any other online computer service. Anywhere.

Of course, it's conceivable that there's a service like ours somewhere that could give you more for your money. But you may have to travel a few light-years to find it.

Instead, all you have to do is visit your nearest computer dealer today. To order CompuServe direct, or for more information, write: CompuServe, 5000 Arlington Centre Blvd., Columbus, Ohio 43220. Or call 800 848-8199. In Ohio and Canada, call 614 457-0802.

CompuServe®

AN H&R BLOCK COMPANY

Circle 57 on Reader Service Card

Personal Consultant Plus

Ernest R. Tello

Can a real expert system be developed and used on a personal computer? The experts at Texas Instruments think so, and they offer Personal Consultant Plus to prove their point.

Personal Consultant Plus version 2.0 ($2950) is a LISP-based expert-system shell written in PC Scheme LISP. It offers frame-based representation, forward and backward chaining, meta-knowledge control, graphics displays, and a broad interface to Scheme LISP.

Personal Consultant Plus (which I'll call PCPlus) includes a complete copy of PC Scheme LISP version 2.0, with full documentation. The program runs on the IBM PC AT and compatibles with at least 512K bytes of memory; 640K bytes is highly recommended. Versions are also available for the TI Professional and Business Pro.

The current version of PC Scheme supports the Lotus/Intel/Microsoft Expanded Memory Specification (EMS) and extended memory for the IBM PC AT and compatibles. [Editor's note: *For a review of PC Scheme LISP, see "PC Scheme: A Lexical LISP" by William G. Wong in the March BYTE.*] The PCPlus program itself comes on two disks, and it also includes a run-time disk, used for producing a stand-alone expert system. I tested PCPlus on a 10-megahertz IBM PC AT–type computer with 640K bytes of RAM, a 40-megabyte hard disk drive, and an EGA display.

The User Interface

PCPlus lets applications users ask the system why information is being requested, how a conclusion was arrived at, and what the user's responses were. The user interface also gives the user a way to avoid tedious repetition when a knowledge base is used frequently. With the `SAVE PLAYBACK FILE` command, if a user gives consistent answers up to a certain point in a knowledge base and gives differing responses from that point on, he or she can save the image of the session up to that point for reloading. Thus, instead of having to answer the same questions each time, the user can pick up a session at the point where it becomes significant.

Because the user interface for PCPlus is easy to understand and use, in the rest of this review I'll concentrate on the development environment in PCPlus.

The Development Environment

The PCPlus development environment is frame-oriented, with context-sensitive menus available through the F2 key. One of the more interesting development commands is `TREE ON`. When this is toggled on, PCPlus displays frames in the form of a tree diagram rather than as a simple list of names. PCPlus uses a frame representation to organize, in the form of parameters and rules, the knowledge contained in applications.

Each frame has a number of properties, which fall into two main groups. The first group consists of properties built into all frames, with values assigned by the developer. The second includes properties with default values that can be changed only after the frame is created.

When you're creating a new frame, PCPlus requests the three frame properties, `GOALS`, `INITIALDATA`, and `TRANSLATION`. The `GOALS` property is a list of the conclusions a frame must seek. The `INITIALDATA` property contains the names of the parameters to be requested from the user each time the inference engine considers the frame. The third frame property, `TRANSLATION`, contains textual descriptions of the frame, which are used to provide output in a more readable and understandable format.

A number of frame properties have default values. The `DISPLAYRESULTS` property has the values *yes* or *no* and, as the name suggests, determines whether the results of processing a frame should appear on the screen. The default value is *no*. The `IDENTIFIER` property names instances of a frame. The default is the name of the frame followed by a hyphen and the number of the instance. The `PROMPTEVER` property contains the textual message to be displayed each time a new frame instance is created. `PROMPT-1ST`, on the other hand, contains a question that determines whether the subproblem of that frame will be considered. Similarly, `PROMPT2ND` asks a question that determines whether another instance of the frame will be entered.

In addition to these properties, a number of knowledge structures are usually

associated with frames. Knowledge structures contain the list of parameters associated with a frame, control the number of times a given frame is instantiated, and list the meta-rules that govern the behavior of the frame.

Dividing a Knowledge Base

Subframes partition a knowledge base into a number of related subproblems. When the inference engine needs to test a rule in an uninstantiated subframe, it must first instantiate not only that frame, but any and all frames between it and the root frame, and it must satisfy all the goals of the intermediate frames before trying the rule it needs.

Developing efficient knowledge bases with PCPlus means taking careful control of the way frames are instantiated. PCPlus provides options in chaining, system functions, rule properties, and meta-rules that give the developer precise control of frame instantiation.

Control with Chains

In PCPlus, rules, like frames, have properties. The major property is that of being either a consequent or antecedent rule. This is established by setting the ANTECEDENT property to *yes* or by letting it default to *no*.

Consequent, or backward-chaining, rules are searched when frame goals are activated. While most common frame situations use consequent rules, antecedent rules have properties that make them indispensable in controlling the behavior of a knowledge base. One of the main uses of antecedent, or forward-chaining, rules is to propagate inferences forward, based on information the system has already determined, so that there will be no need to further query the user or try more rules.

Forward-chaining rules do not seek the necessary parameters for evaluating a rule, but instead can rely on values already known to the system to prove a rule. No matter how many times an antecedent rule fails, it may still fire at a later point when the needed information becomes available. However, once a antecedent rule fires, it is never evaluated again.

A rule may also have the property of being self-referencing. A self-referencing rule, which can be either forward- or backward-chaining, references the same parameter in both the IF and THEN clauses. One of its uses is to provide a default value to a parameter whose value the system has been unable to determine. So, for example, the rule

```
IF:     BUSINESS-TYPE =
        SOLE-PROPRIETOR AND
        NUMBER-EMPLOYEES = UNKNOWN
THEN: NUMBER-EMPLOYEES = 1
ANTECEDENT: YES
```

assumes, unless told otherwise, that a sole proprietorship has one employee.

Control with Rules

System functions are used in rules that make up knowledge bases. They are applied in both the IF and THEN sections of rules to state relationships between facts.

IF expressions of rules use predicate functions, and THEN expressions use conclusion functions. Text and arithmetic functions act on the data that their names suggest. Auxiliary functions are used in IF and THEN statements that provide assistance in the evaluation of parameter values. The functions in the auxiliary category are generally used in more complex knowledge bases dealing with less common areas of information.

The DOBEFORE and UTILITY rule properties capture knowledge about application-level control. The UTILITY property of a rule measures how useful or important the rule is in determining the value of a goal parameter. The inference engine tries rules with the highest UTILITY value first; rules with a negative UTILITY parameter are not tried at all. The UTILITY property permits control of the order of rule-processing without the need for meta-rules. However, for more precise control, you can write meta-rules that fine-tune the higher level control by modifying the value of the UTILITY parameter, depending on the behavior of the rules.

Meta-rules modify the list of rules to be processed to make knowledge-processing more focused and efficient for the problem at hand. They do this by eliminating rules from the list altogether and by reordering them into a more propitious sequence. In PCPlus, mapping functions are often used as tools within meta-rules. These functions access and evaluate rules, frames, and parameters, and map the elements meeting certain criteria into a list.

Linking to a Database

You can use PCPlus with existing databases created by dBASE II, dBASE III, and dBASE III Plus. For this purpose, PCPlus provides several functions that let you use a knowledge system as either a front end (gathering and maintaining information) or a back end (accessing information) to the database, or as both.

An important limitation of the dBASE functions in PCPlus is that they recognize only numeric and character data types; they do not recognize the data, logical, and memo data types. When you use a system as a front end, you can update dBASE data files by including the appropriate dBASE function in the THEN clause of a rule. For this to work, you must install the dBASE program in the same directory as PCPlus.

Personal Consultant Plus version 2.0

Type
Frame-based expert-system shell

Company
Texas Instruments
Data Systems Group
P.O. Box 2909
Austin, TX 78769-2090
(800) 527-3500

Format
Three 5¼-inch floppy disks

Computer
IBM PC AT and compatibles, TI Professional, or TI Business Pro with at least 512K bytes of memory (640K bytes recommended) and MS-DOS 3.1 or higher

Language
PC Scheme LISP

Documentation
388-page *PCPlus User's Guide and Reference Guide* (two volumes)

Price
$2950

A Picture of Knowledge

PCPlus has broad support for using high-resolution (including EGA) graphics with expert-system applications in a variety of ways, for both IBM and TI computers. The SNAPSHOT utility is a program that lets you capture graphics screens in a compressed file format, for use with knowledge-system applications. You can incorporate graphics screens into Help facilities, use them as prompts when a knowledge system needs to get some critical information from a user, and use them to display information that accompanies the conclusion of a knowledge-processing session. For example, in an expert system for diagnosing difficulties with technical equipment, detailed labeled diagrams of different views and states of the apparatus can be provided.

Integrating with PC Scheme LISP

One of the most important features of PCPlus for LISP programmers is its open architecture. You can use PC Scheme

continued

LISP functions to customize knowledge bases, and PCPlus allows two different forms for writing the entire knowledge base: You can write it either in the ARL (augmented rule language) syntax that PCPlus uses, or in Scheme LISP syntax.

Most of the frame and rule properties in PCPlus can be defined with custom LISP functions coded in PC Scheme. For example, the EXPECT property can access a LISP function that returns a list of the possible values a parameter can assume. In addition, a mechanism is provided that lets you include custom LISP code when you first load PCPlus. Such customization can range from resetting default values in the PCPlus environment to adding new functions.

A Stand-Alone Expert

PCPlus comes with a special run-time disk. Run-time versions of applications are prepared with the BUILD command. The disk is copy-protected, so any additional run-time disks have to be purchased from Texas Instruments; they cost $95 each, or 20 for $995. The code of the knowledge base packaged in a run-time system is protected so that it cannot be modified; furthermore, the run-time disk acts as a key disk and must be present even when the application is copied onto a hard disk. All in all, the run-time system provides the commercial developer with an easy-to-use system that protects the integrity of the knowledge base and the programming.

An Expert on Your Desk

PCPlus is a full-featured development and delivery environment for PC expert systems. The prime characteristic that distinguishes PCPlus from other shells is its total reliance on the frame as a representation of knowledge. Other systems may provide the developer and user with the option of organizing a knowledge base into frames; PCPlus forces organization of knowledge into at least one frame.

A major limitation of PCPlus, however, is that it does not provide a standard way to change the method of calculating certainty factors. This is an important issue for certain problem-solving strategies. In PCPlus, for a rule to have a value of *true*, all the premises in the rule must test true. But there are cases in which it is desirable for a rule to succeed if a certain percentage or combination of premises is true. It might be possible to overcome this limitation by using the interface to Scheme LISP; but this would not be a trivial undertaking, and the programmer would have to provide complete documentation of the necessary aspects of the implementation.

For those adept at LISP programming, the best feature of PCPlus is undoubtedly its open architecture, which lets you fully integrate programs in PC Scheme with PCPlus applications. PCPlus has great potential as an intelligent front end to a complex knowledge base. With the object-oriented SCOOPS extension to PC Scheme and its other powerful features, like environments, engines, and continuations, some very powerful applications are conceivable, which would owe no apologies to AI systems running on far more expensive hardware. ■

Ernest R. Tello (1518 West Cliff Dr., Santa Cruz, CA 95060) is director of research and development at Integral Systems. He is the author of the upcoming Mastering AI Tools and Techniques.

Guide

William Hershey

In 1965, Ted Nelson proposed hypertext, a way to link interrelated information so computer users could jump from topic to topic, find related subject areas, and generally extract only what they needed from large quantities of information. Guide 1.0 from OWL International attempts to bring this concept to the Macintosh. At $134.95, Guide is an affordable introduction to the subject. [Editor's note: *OWL recently announced an IBM PC version of Guide for $199.*]

What Is Hypertext?

Word processors present information in a straightforward, linear fashion: You read the first paragraph, then the second, and so on. Outline processors let you create documents with details that are hidden in a hierarchical tree structure.

Hypertext takes the next step, creating complex networks of information linked by pointers and cross-references. With a true hypertext system, you can read an entry, jump automatically to other related entries, find cross-references to these entries, and easily jump back to the first entry. A true hypertext system provides links between text, graphics, audio, video—any kind of information that a computer can digitize and access.

While limited to text and graphics, Guide lets you create hypertext-type documents on a Macintosh with 512K bytes of memory. The main Guide program lets you create Guide documents (called Guidelines), read them on the screen, save them as MacWrite documents, and (if you insist) print them. OWL also offers three read-only methods for Guidelines (one is included; two are optional), each with a different objective.

Reading a Guideline

A Guideline can be a mixture of text and graphics, much like a MacWrite document. But certain words, phrases, or graphic objects can be "buttons" that provide links to hidden text and graphics. Text buttons may appear in any style, but they typically have distinctive attributes, like boldface or italics, to distinguish them from the rest of the text.

Boldface text, for example, indicates a *replacement* button. Clicking on this button reveals hidden replacement text or graphics that are inserted after the button or displayed on top of it; it's similar to expanding a heading in an outline processor to reveal more details.

Underlined text indicates a *note* button. When you click on one of these, a pop-up text/graphics definition of the item appears in a window at the upper-right corner of the screen. It remains on the screen as long as you hold down the mouse button.

The use of italics indicates a *reference* button, which opens up a new window to show a different Guideline document (at a specific reference point within that document) or branches to a different part of the Guideline containing the reference button.

When you click a button and Guide displays the appropriate replacement or reference, you may encounter more buttons that will take you elsewhere. But you may wish to return to the place in the Guideline where you clicked the button. You can make a replacement disappear by placing the pointer over it and clicking the mouse. If a reference button has moved you to a new window for the referenced material, you can return to the original Guideline by clicking on a backtrack symbol that appears at the top of the window's vertical scroll bar. Guide keeps track of up to 32 cross-references, so you can backtrack from deep within a tree of references.

However, if you open up several cross-

reference windows, keeping track of where you are can be a problem, especially with a poorly designed set of Guidelines. I'd like Guide to have a pull-down menu listing the open document windows, as MORE and Excel do, to supplement the backtrack feature for finding the right windows. Although you can size and move the windows and make any window active by clicking on it, this type of exploration can be cumbersome.

Writing a Guideline

Writing a Guideline is somewhat more difficult than reading one. This is due partly to the program's flexibility, and partly to some quirks in the user interface. If you know how to use MacWrite, entering text is easy enough; the tricky part is dealing with the buttons.

While the interface is 100 percent Macintosh, the Make menu can cause confusion. Make has nine menu choices for making buttons, plus a `Set Attributes` item that affects the attributes of individual buttons as well as of defaults. One entry in the Make menu, `Inquiry`, is a misnomer that performs two very different functions: bracketing groups of replacement or reference buttons that are to be mutually exclusive, so that clicking one button hides the others as the replacement or reference appears; and bracketing text for styling or font changes. In addition, creating a link between a note and its definition differs, depending on whether you are using the definition once or more than once. The Make menu needs simplification, to clean up the terminology and make the manner of creating the three basic button types more obvious.

Another problem with Guide is the lack of an `Unmake` command for replacement buttons. The `Undo` command (found, as with most Macintosh applications, under the Edit menu) will unmake a button you've just made; but if you change your mind about a button later, you have to cut and paste the button and its replacement separately to another part of the Guideline if you want to salvage them.

Guide Graphics

Although you can't create graphics with Guide, you can cut and paste MacDraw or MacPaint images into a Guideline. When you select a graphics image in Guide, the object will have MacDraw-like handles that you can use for stretching and shrinking. Also, if you make a

continued

Guide version 1.0

Type
Hypertext document-creation program

Company
OWL International Inc.
14218 Northeast 21st St.
Bellevue, WA 98007
(206) 747-3203

Format
Two 5¼-inch floppy disks; also available on two 400K-byte 3½-inch floppy disks; not copy-protected

Computer
Apple Macintosh with at least 512K bytes of memory; mouse required

Documentation
198-page reference manual; numerous files containing sample, tutorial, and help Guidelines

Price
Guide (including MiniGuide): $134.95
Guide Envelope: $199.95
Guidance (including Guide): $500; with distribution license for Guidance applications: $2500

guideline's window narrower, Guide not only reformats the text to the new boundary, but scales down the graphics as well. You can also drag graphics objects and use Guide's `Pull to Front` and `Push to Back` commands to rearrange them.

You can make any graphics object into a button, which means that you can link various parts of a picture to textual descriptions of the parts or to exploded pictures that show more detail.

Creating Stand-Alone Guidelines

Guide comes with a MiniGuide desk accessory that lets you read (but not write) Guidelines from within other applications. Unfortunately, OWL does not give you permission to distribute MiniGuide to anyone else.

The Guide Envelope system, available separately for $199.95, lets you convert Guidelines to stand-alone applications, called Envelopes, which you can copy and distribute to as many people as you want. The system is also read-only; you still need to have the Guide program to create the Guidelines. The Envelopes that you create look just like the original Guidelines, except that you cannot change them; both MiniGuide and the Envelope system have a `Find` command, but they lack the main Guide program's `Change` command. Both MiniGuide and Guide Envelopes let you copy material from Guidelines to the Macintosh Clipboard.

The third read-only package is called Guidance, a $2500 package designed to replace printed documentation manuals with interactive, on-line, hypertext documentation. Like MiniGuide and the Guide Envelope system, Guidance is based on Guidelines, which developers can incorporate into applications as desk accessories with context-sensitivity. This type of on-line help system is an application for which Guide is perfectly suited.

A Worthwhile Introduction

Guide's innovative capabilities easily outweigh the current minor flaws in its user interface. The product points the way to future "hypermedia" systems that will link animated video and sound with massive text and graphics files. For now, Guide is an affordable, highly functional program that will let you dabble in hypertext—and maybe get your points across more effectively. ■

William Hershey (The MITRE Corporation, 1820 Dolley Madison Blvd., McLean, VA 22102) is a systems engineer and an instructor in computer applications at the University of Maryland's University College.

Intelligent statistics. Consider the alternatives.

Today there are numerous microcomputer statistics software packages to consider.

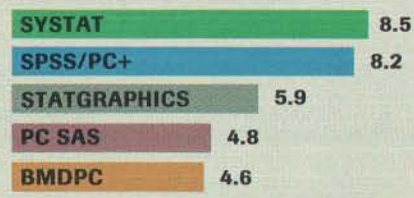
But, in the considered opinion of many experts, there is one that is clearly better.

Highest rated.

In its recent review of the five leading microcomputer statistics programs, *InfoWorld* concludes that Systat™ Version 3.0 is "unrivaled in performance", "tops in number crunching power" and "unfailingly accurate."

And *InfoWorld* doesn't stop here, but goes on to rank Systat as the Number One statistics package of the group.

In doing so, they aren't alone. Every published independent comparative review rates Systat at the top of the list.



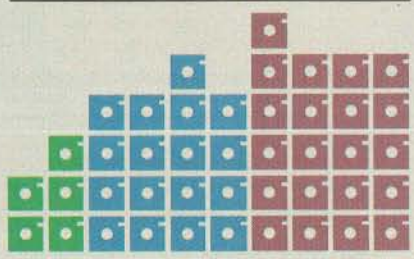
Of the statistics packages reviewed by InfoWorld, *Systat rated highest, as it has in every published competitive review.*

Some practical benefits.

Such ratings are important because they relate directly to the quality of your work, not just to glitzy features. For example:

Are capabilities important to you? Systat gives you more statistical capabilities than any microcomputer statistical package, including three major procedures that PC SAS® and SPSS/PC+® programs simply don't offer.

Is accuracy important? Systat gives you more accuracy. In fact, numerous reviews and technical conference proceedings consistently prove Systat to be the most accurate statistical package available.



Although more comprehensive, Systat requires less than ½ the commands and has ½ the bulk of competitive programs. Compare its 5 disks to 17 for SPSS/PC+ and 21 for PC SAS!

Is ease of operation important? Systat operates on less than ½ the commands of its two largest competitors, with less than ½ the bulk. According to *InfoWorld*, "Systat's commands are terse, and a few keystrokes will do amazing things."

Is cost important? Systat costs less than any other major package: less than ½ the price of the comparably equipped PC SAS or SPSS/PC+.

Truly interactive.

Unlike its major competitors, Systat has *not* ported some 20-year-old code from a mainframe program. Written specifically for microcomputers, Systat Version 3.0 uses an incredibly small amount of disk space: only 1.4 megabytes versus their 5 to 10 megabytes.

What's more, the package is genuinely interactive, freeing you from rigid command protocols. In doing so, Systat allows you to approach statistical problems more intelligently: letting you work the way you think instead of forcing you to think the way it works.

Next to this, the alternatives to Systat don't look very bright.

SYSTAT™

For more information and a *complete* copy of the *InfoWorld* review, call 312 864.5670, or write Systat Inc., 1800 Sherman Avenue, Evanston, Illinois 60201.

Systat operates on IBM PCs® and compatibles, MS-DOS® and CP/M® machines, several UNIX® minicomputers and mainframes, and the VAX/Microvax®. Menu/windowed Macintosh® version also available. Single copy price $595 USA and Canada, $695 Foreign. Site licenses and quantity prices available.

Systat. Intelligent statistics.

PRO-PLUS+ GUARANTEES THE LOWEST PRICE FOR QUALITY COMPATIBLES OR YOUR MONEY BACK!*

PRO-PLUS+™ XT TURBO

$629 COMPLETE!

With One 360k Floppy and One 20Mb Hard Drive

ONLY $939

STANDARD FEATURES:

IBM PC/XT Compatible
4/8 MHZ CPU speeds
640k RAM Memory
Two 360k Diskette Drives
8 I/O Slots
150 Watt Switching Power Supply
FCC Approved Chassis
AT Style Keyboard
High-Resolution Amber Monitor
Hercules Compatible Graphics Card
Parallel Port
User Manual
Complete and Ready to Run!

NEW! PRO-PLUS+™ 10 TURBO

$699 COMPLETE SYSTEM!

COLOR MONITOR EXTRA

Shown with Optional Color Monitor

STANDARD FEATURES:

IBM PC/XT Compatible
4.77/10 MHZ CPU speeds
Keyboard selectable
640k RAM Memory
Two 360k Diskette Drives
8 I/O Slots
Reset Switch and Keyboard Lock
150 Watt Switching Power Supply
FCC Approved Chassis
AT Style Keyboard
High-Resolution Amber Monitor
Hercules Compatible Graphics Card
Parallel Port
User Manual
Complete and Ready to Run!

PRO-PLUS+™ AT TURBO

$1169 COMPLETE!

386 Version ONLY $2799

STANDARD FEATURES:

IBM AT Compatible
6/10 MHZ CPU speeds
1Mb RAM Memory
One High Density 1.2 Mb Diskette Drive
Hard/Floppy Disk Controller Card
8 I/O Slots
200 Watt Switching Power Supply
FCC Approved Chassis
Enhanced AT Style Keyboard
High Resolution Amber TTL Monitor
Hercules Compatible Graphics Card
On-Board Clock/Calendar
Parallel Port User Manual
LAN & Multi-User Ready
Complete and Ready to Run!

Many other configurations and options available. Call Pro-Plus+ for quotes.
Requests For Bids on High Volume Orders Welcomed.

HARD DRIVES

Seagate 20Mb w/contr. ST225.... $335
Seagate 30Mb w/contr. ST238..... 369
Seagate 20Mb for AT ST225..... 289
Seagate 30Mb for AT ST4038..... 529
Seagate 40Mb for AT ST251..... 569
Seagate 80Mb for AT ST4096..... 929

MONITORS

Amber TTL w/Tilt Swivel Base..... $89
Color RGB Monitor..... 269
EGA Monitor w/Card..... 569

ADD-ON BOARDS:

Mono Graphics w/Par. Port..... $59
Color Graphics w/Par. Port..... 69
EGA Adapter..... 169
XT Multi-Function w/Clock and Ser., Par., & Game Ports..... 69
AT Multi-I/O w/ Ser., Par., & Game Ports..... 69
2MB AT RAM Expansion..... 295
Serial Port..... 26

PRINTERS

Panasonic / Okidata / Citizen
Toshiba / Hewlett Packard

MOST ORDERS SHIPPED WITHIN 48 HOURS

TERMS: All prices subject to change without notice. Shipping is FOB Phoenix, AZ. Minimum shipping charge is $2.50. UPS C.O.D. is $1.50 additional. Arizona residents only, add 6.7% sales tax. Allow extra two weeks shipping time when paying by personal or company check. No extra charge for MasterCard or Visa orders. Add 4% for American Express orders. All shipments sent insured. Defective merchandise may be returned for repair or exchange only. Merchandise returned for credit is subject to a 15% restocking charge. A Returned Material Authorization number obtained from **Pro-Plus+** in advance must be shown on the shipping label for all returns.

All systems are burned-in and tested for 24 hours. We configure systems boards, set up switches, format hard drives, perform all diagnostics, and check the system with your monitor. All systems are FCC approved: Class 15J, Part B.

IBM PC/XT and AT are registered trademarks of IBM Corp.

* PURCHASE WITH CONFIDENCE!

Here is our commitment to you:

30 Day Money-Back Guarantee – *If you are not satisfied with any item you purchase from* **Pro-Plus+**, *you may return it within 30 days of the date of shipment for a full refund. Returns must be "as-new", not modified or damaged, with all warranty cards, manuals, and original packing intact, and must be pre-authorized by* **Pro-Plus+**, *and be shipped repaid and insured.*

One Year Limited Warranty – **Pro-Plus+** *warrants the products it manufacturers to be free from defects in materials and workmanship for a period of one year from the date of shipment. During this one year period,* **Pro-Plus+** *will repair or replace, at its option, any defective products or parts at no additional charge, provided the product is returned, shipping and insurance prepaid to the* **Pro-Plus+** *repair facility.*

MasterCard VISA AMERICAN EXPRESS

CALL TOLL FREE:

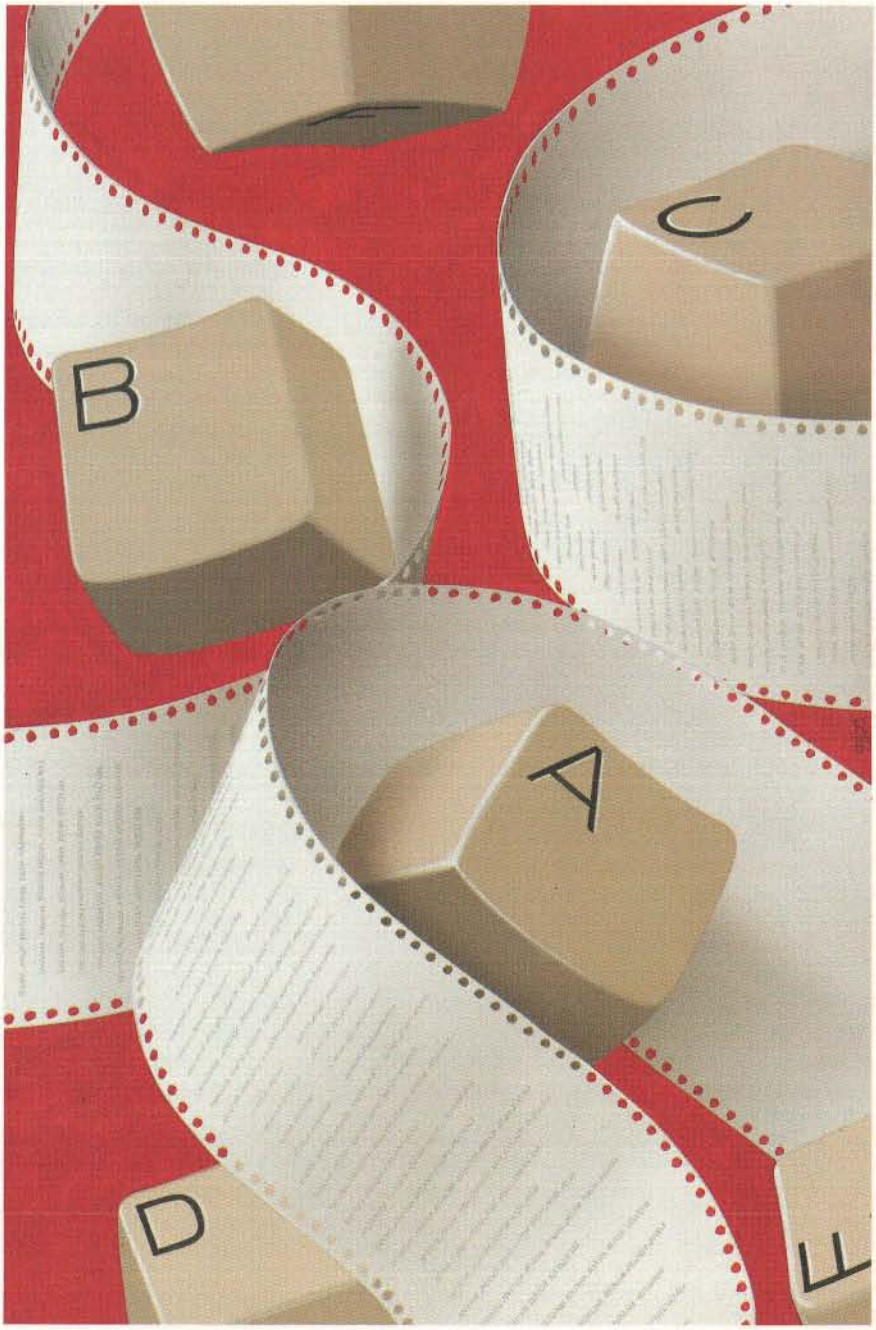
1-800-621-8285

(In Arizona, Call: 1-252-0017)

34 W. Monroe 300, Phoenix, AZ 85003

Circle 175 on Reader Service Card (Dealers: 176)

Kernel



CONNECT.

OCR SCANNING

Our "SCANNING CONNECTION" system can be used to read your paper documents into a PC. Pictures and graphs can be scanned and saved in various file formats for use by many word processing and desktop publishing systems. Text images can be converted to character text for use with most word processing and typesetting systems. Images can be sent over telephone lines to another PC or a facsimile machine.

We have developed a special controller card for high speed compression of images and for character recognition. Books, magazines, newsprint, reports and typed documents can be read by our OCR software. The software can be trained to recognize almost any font style. System prices including scanner and software start at $1795.

9-TRACK TAPE

With our "TAPE CONNECTION" system you can read and write most 1/2" 9-Track magnetic tapes using your PC. Tapes can be 800, 1600, or 6250. Our file transfer software can process ANSI labeled tapes from most computer systems including DEC, HP, HONEYWELL, and IBM. Large files from multivolume tape reels can be transferred to a disk at rates up to 5 MB/min. Software is provided to use the system for backup of the hard disk on your PC.

With more than twenty years experience in working with tape drive systems, we can solve most PC tape conversion problems. We can supply more than ten different tape drive models. System prices including tape drive, controller card, and software start at $3495.

DISKETTE CONVERSION

We specialize in conversion systems and can transport your documents or images to almost any computer, word processing, or typesetting system. With our "DISKETTE CONNECTION" system you can read and write most 8", 5¼", or 3½" diskettes using your PC. We support systems from DEC, CPT, WANG, NBI, LANIER, HONEYWELL, and XEROX. We support most IBM systems including 3741, S/36, PC/36, 4300, and Displaywriter.

Since 1981 we have developed hundreds of software programs and designed many specialized diskette hardware products. With thousands of installations worldwide, we are probably the world leader in manufacturing diskette conversion systems. System prices including diskette drive, controller card, and software start at $1195.

FLAGSTAFF ENGINEERING

Circle 97 on Reader Service Card
(Dealers: 98)

1120 Kaibab • Flagstaff, AZ 86001 • 602-779-3341

Compucal Europe • 13 Rue Rossewald • 75015 Paris • Tel 530 07 37 • Telex 205431F

New Life for Lucy

Jerry Pournelle

Jerry's genuine, original IBM PC receives a new lease on life

It doesn't seem like a month since the last column, and now that I think of it, it hasn't been. Westercon, the Western Regional Science Fiction Convention, is next weekend, so I'm doing this almost a week early. Last month, I was more than a week late, so this "month" has only had two weeks in it. Larry Niven and I have been hard at work three days a week on *The Moat Around Murcheson's Eye*, using up even more time. Oh, well. There's plenty to write about.

Pumping Up Lucy

It all started with the Sota Technology MotherCard 5.0. This is a board you can drop into an ordinary IBM PC to turn it into an AT compatible. After you put in the board, you remove the 8088 from the PC's motherboard and run a cable to it. The result is said to be much better than an accelerator board, because it's 100 percent AT-compatible, and it will run 80286 protected-mode software (assuming that any gets written).

I'd heard good things about the Sota MotherCard, and when one arrived it seemed like a good thing to install in Lucy Van Pelt, our original IBM PC. Of course, if we were going to upgrade Lucy, we figured we might as well go all the way and install a hard disk.

Lucy has always had a sort of hard disk: a 500K-byte bubble-memory board from Helix Systems & Development. There was a time when I was sure that bubble memory was going to replace spinning metal for mass storage. Bubbles are faster than hard disks and totally nonvolatile; you can pull the Helix card out of one machine and drop it into another with all the files intact. Bubbles are also a great deal more rugged than hard disks. They can take higher temperatures and don't generate much heat, and they'll take as much mechanical impact as any other board will take, so that your "hard disk" is no longer the most fragile part of the system.

Alas, Intel never managed to make bubble-memory chips small enough or cheap enough to be a serious contender, while hard disks just kept getting cheaper and cheaper. Our Helix card has operated flawlessly for years, but it holds only half a megabyte, and that's just not enough. I'll keep it for when I put together a rugged portable PC, but it was long past time to give Lucy 20 megabytes.

The Sota MotherCard would work with Lucy's old 75-watt power supply, but a hard disk would need more; time to replace the power supply, too.

First Try

Someone, I don't recall who, had recommended a company called Unitex in Silicon Valley. I called and ordered a 150-W power supply ($55) and a 20-megabyte hard disk kit ($375). The package came just before we went off to COMDEX. When I got back, it took about half an hour to install the new power supply: no directions needed, just be logical. You can't get the power plugs in wrong. Lucy ran fine as soon as I turned the power on.

Then came the hard disk. Alas, neither disk nor controller had any instructions or documents whatever, other than a printout that listed the (few) bad sectors on the hard disk. I removed the Helix bubble-memory card and the B: floppy disk drive and installed the hard disk and controller. There was only one way to put in the cables.

The disk powered up—and was *very* noisy. The computer booted from the floppy—and insisted there was no hard disk installed. The controller has several jumper sets, but I haven't the foggiest notion of what they do. My son Alex took the disk off and tried it on a later-model PC, and it appeared to work; but when we brought it back here, nothing.

One thing I might have tried, but didn't, is the SpeedStor hard disk utility (see last month's column); but we'd spent a lot of time on this, and the thing was so noisy I wasn't too happy with it anyway. One of these days, I suppose I'll send it back. They've no business selling "kits" with no documents. Back in went the Helix bubble-memory card.

Priority One

About then I saw a flier for a blowout sale by Priority One. I've been buying equipment from that company for years, and one day on the way to the Burbank Airport, I noticed a Priority One showroom on Hollywood Way. Among the items advertised was the Gold Card 21, a 20-megabyte hard disk and controller on a card. The price was ridiculously low, I'd just got in some royalty checks, and it really was time for us to upgrade Lucy Van Pelt.

They also had a great price on the AST-2000 hard disk drive for the Macintosh Plus, big discounts on 3½-inch floppies, surge-suppressor boxes for about 30 percent of list price, and a bunch of other stuff I'd been putting off getting. To top it off, we were going out that way anyway, to a nursery to replace a dead azalea.

I sometimes think I'd be better off sticking to mail order. When I get to a sale at a computer store, it's hard to know when to stop. Anyway, about two hours and a thousand dollars later, we were back with a fuchsia to replace the azalea and a trunk full of computer hardware.

Gold Card 21

I have a lousy memory, and it doesn't seem to be getting any better. It used to be

continued

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future.

I could take comfort in having a better memory than my partner Larry Niven, but even that's getting doubtful.

What I kept forgetting was just how few slots there are in an original IBM PC—and how closely crowded they are. The result was a nasty surprise when I opened the machine to install the Gold Card 21.

Lucy Van Pelt was full up. Of course, I'd intended to remove the Helix board; but that wasn't going to be good enough, because while the Gold Card 21 needs only one slot, it's wide enough that it must be next to either an empty slot or a half-length card. I didn't have any half-length cards in the machine.

Fortunately, that turned out to be no problem. The video card in Lucy was a vintage full-length Hercules monochrome graphics board. It had served us well and had never given a problem, but now I needed half a slot. I recently got a Paradise Systems Hi-Res Graphics Card. That's a half-length card that's advertised to be Hercules-compatible, and for extras it has color capability as well.

There was a mild moment of panic when I replaced the Hercules board with the Paradise board and got no output at all, but that was fixed by moving the big slide switch on the Paradise card from "Color" to "Mono." I then ran a few programs that require Hercules graphics, and they all worked. I can't say I've done extensive tests, but none of us can tell the difference between the Hercules and the Paradise boards.

That gave me an open half slot, which I could arrange to be next to the Gold Card 21. I put in the Gold Card. So far, I hadn't done more than glance at the instructions. They're written in Janglish or something like it; complete, understandable, but in what is most charitably described as awkward syntax. There's a picture showing where to look for switch blocks on your PC motherboard, but the only instruction is, "NOTE! Switch settings will be in your systems technical manual. Refer to it."

I didn't remember ever doing that, but presumably I had once referred to "it," since Lucy believed the Helix board was a superfast hard disk. I figured the heck with it and booted off the floppy. Voilà! `DIR C:` established that I indeed had a 21-megabyte hard disk already formatted.

The Gold Card 21 manual carefully explained that the disk was already set up to use DOS 2.0 or 2.1, but if you wanted to boot up anything else, you'd have to reformat the disk using the DOS utility FDISK. I'd never used that before, but the manual made it sound simple, so I tried it. Amazingly, it *was* simple. Everything worked the way the Gold Card manual said it would.

After that, Lucy would boot DOS 3.2 off the hard disk. So far, so good.

AST SixPakPremium

Over the years, Lucy has had just about every kind of speedup board. For a long while, we used an Orchid PCturbo 186, which worked quite well. I forget why we took it out, probably to make room for something else, given the PC's limited number of slots. I certainly don't recall any problems with the Orchid board.

One board that stayed in was an STB Systems' Rio Plus board we originally bought from Priority One in the summer of 1984 for the Zenith Z-150. We had problems with it for the Z-150. Those were the days when you bought an IBM PC with 64K or 256K bytes of memory and then added 64K-byte chunks of memory (up to 384K bytes) with an add-on like the Rio Plus.

The Z-150 came with a capability of 320K bytes on the motherboard, and unless you'd filled all those sockets with memory chips, the Rio Plus couldn't add its memory to the system. The Z-150 also came with two installed serial ports. Alas, the Rio Plus has a serial port that must be addressed as either 1 or 2 (it wasn't possible to make it 3 or 4), which meant that it clashed with the Z-150. You could get a PAL that would disable the Rio Plus's serial port, but that seemed a waste, so we installed something else in the Z-150 and put the Rio Plus in the PC.

The Rio Plus could, in fact, bring the PC up to 640K bytes of memory, but there are other ways to do that; mostly, it served as a clock. Then in one DOS change or another we lost the BASIC program that set the Rio Plus's clock. Maybe you just need to use BASIC and `TIME$`; I'd forgotten, and we'd lost the Rio Plus's manuals. Anyway, by now the only real purpose the Rio Plus board served was for the serial and parallel ports. It did look as if it could go.

The obvious choice for a replacement was the Sota MotherCard that started the upgrade in the first place. It even has a built-in battery-backed clock. The only problem was that it was getting late, and I wanted to install and test a bunch of stuff on the new Gold Card disk—but not with an unfamiliar speedup card. We normally use the PC as the Q&A data-entry machine to log in the hardware and software that threatens to engulf us in a flood; time enough to put in the MotherCard after a couple of weeks of testing the Gold Card.

There were a bunch of other candidates, but the one on top was the AST SixPakPremium, which offers two serial ports, a parallel port, expanded memory, a clock, and suchlike, and it even offers DESQview if I want it.

Installing that took about 5 minutes: put the card in the machine, turn the machine on, and invoke the installation program that comes with the SixPakPremium. The manuals explain what's going on, and there are no really difficult choices.

The result is that we now have an IBM PC with quite a fast (15-millisecond track-to-track) hard disk, a 512K-byte RAM disk, a megabyte of expanded memory, a print spooler, and a real-time clock.

The CompuPro ARCNET PC board works fine with this arrangement. The network board takes up a full slot, of course, so the PC is full: floppy controller, hard disk card, AST SixPakPremium, Paradise Hi-Res Graphics Card, and network board. I have a bunch of cards that are said to speed up a PC, including the Orchid TurboEGA that not only speeds up the machine but gives it EGA capability as well. The TurboEGA will fit in the video board slot, only it can't in this case since it's a full-length board, and there'd be no room for the Gold Card. Sigh.

I'll try a bunch of accelerators and suchlike over the next couple of weeks. From the specs, the MotherCard still sounds like the best of the lot, but we'll see.

AST-2000

We also picked up the AST-2000 SCSI hard disk drive for the Macintosh Plus. The box pictures a unit with a tape backup and says prominently: "AST-2000 High performance, hard disk SCSI subsystem for the Macintosh Plus and the Apple IIe. Featuring 20 megabyte disk capacity with 20 megabyte cartridge tape drive." I figured that what I was getting was a disk with tape backup, and while I hadn't expected the tape backup, it was welcome; so I asked the manager what size tapes it took.

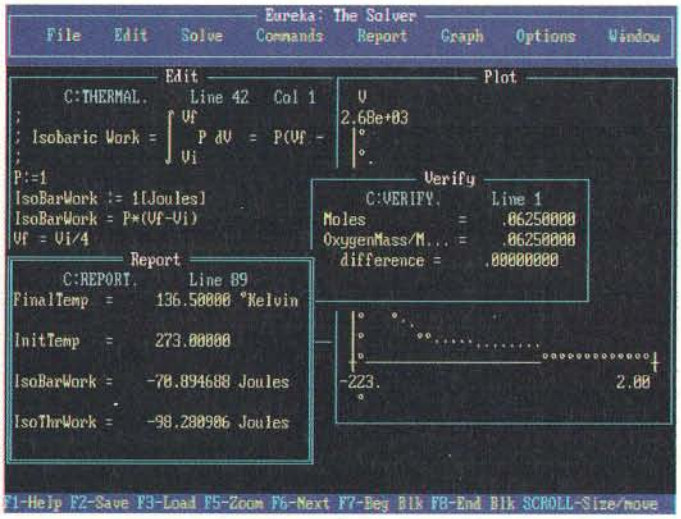
He didn't know, but he was sure they packed one in the box, so we opened it. Hah. Not only was there no tape, there was no tape drive. Eventually, we found a tiny sticker on the box that said "drive unit only." Since I hadn't really expected a tape drive unit at that price, I wasn't upset, but the box sure fooled everyone, including the store manager.

When I got it home, I found the drive packed in foam. A separate box contained cables, documents, and a 3½-inch disk of control programs. The documents talked of an "Apple SCSI Terminator" and pictured a large lumpy thing in the cable between the Mac and the drive. That scared me for a moment, since I was sure I didn't have a "Terminator"; but, in fact, that and everything else was packed neatly in the cable bag.

continued

How Eureka: The Solver instantly solves equations that used to keep you up all night

The state-of-the-art answer to any of your scientific, engineering, financial, algebraic, trigonometric, or calculus equations = Eureka: The Solver™



Eureka instantly solved this Physics equation by immediately calculating how much work is required to compress isobarically 2 grams of Oxygen initially at STP to ½ its original volume. In Science, Engineering, Finance and any application involving equations, Eureka gives you the right answer, right now!

Eureka can solve most equations that you're likely to meet. So you can take a mathematical sabbatical.

Most problems that can be expressed as linear or non-linear equations can be solved with Eureka. Eureka also handles maximization and minimization, plots functions, generates reports, and saves you an enormous amount of time.

Eureka instantly solves equations that would've made the ancient Greek mathematicians tear their hair out by the square roots—and it's all yours for only $167.00.

It's easy to use Eureka: The Solver

1. Enter your equation into the full-screen editor
2. Select the "Solve" command
3. Look at the answer
4. You're done

You can then tell Eureka to

- Evaluate your solution
- Plot a graph
- Generate a report, then send the output to your printer, disk file or screen
- Or all of the above

Minimum system requirements: For the IBM PS/2* and the IBM* and Compaq* families of personal computers and all 100% compatibles. PC-DOS (MS-DOS*) 2.0 and later. 384K.

Eureka: The Solver is a trademark of Borland International, Inc.
 BI-1145

BORLAND INTERNATIONAL

You can key in:

- ☑ A formula or formulas
- ☑ A series of equations—and solve for all variables
- ☑ Constraints (like X has to be < or = 2)
- ☑ A function to plot
- ☑ Unit conversions
- ☑ Maximization and minimization problems
- ☑ Interest Rate/Present Value calculations
- ☑ Variables we call "What happens?," like "What happens if I change this variable to 21 and that variable to 27?"

"Merely difficult problems Eureka solved virtually instantaneously; the almost impossible took a few seconds.

Stephen Randy Davis, PC Magazine"

Eureka: The Solver includes

- ☑ A full-screen editor
- ☑ Pull-down menus
- ☑ Context-sensitive Help
- ☑ On-screen calculator
- ☑ Automatic 8087 math co-processor chip support
- ☑ Powerful financial functions
- ☑ Built-in and user-defined math and financial functions
- ☑ Ability to generate reports complete with plots and lists
- ☑ Polynomial finder
- ☑ Inequality solutions

BUY ONE GET ONE FREE!

Buy either Turbo Basic* or Eureka from 8/1/87 through 9/30/87 and get your choice of selected* Borland product free! See your dealer for details or call Borland Customer Service at (408) 438-8400.

Offer includes SideKick, SuperKey,* Turbo Lightning,* and Turbo Pascal*. Offer void where prohibited by law.

For the dealer nearest you or to order by phone

Call (800) 255-8008

In CA: (800) 742-1133;
In Canada: (800) 237-1136

BORLAND

Circle 34 on Reader Service Card (Dealers: 35)

The AST-2000 is a bit larger in footprint than the Mac, but it's a good height and fits reasonably well underneath the computer. Installing it took about 2 minutes, including installing the software. It really was as simple as the directions say.

The hard disk works fine, and it sure speeds up the Macintosh, particularly for games like Wizardry that need disk access while you're playing. Alas, I haven't found a way to put Strategic Conquest on the hard disk; that game doesn't do much disk access during the game, but it does take forever to get started. Oh, well. At least I can save games on the hard disk.

There's one disconcerting "feature" that I suppose can happen with any SCSI hard disk. If you have a floppy disk in the internal drive when you power up, the system boots up from the floppy, then tells you that the disk is unreadable. It wants permission to initialize it. The first time that came up, the floppy in question was Strategic Conquest, and I sure didn't want *that*, so I clicked on `Eject`. Nothing happened. I had to turn off the system to recover. I later learned that it's the *hard* disk that it wants to initialize, and, of course, it can't eject it.

There are two morals to this story. One, don't boot with a floppy in the system if you have a SCSI hard disk. Two, Apple should have put a control lever on the Mac so you can eject floppies without begging permission. Oh, well.

Another thing that has always galled me is that hard disks for the Mac cost about double what the same capacity costs for the PC. They're also very much larger than PC hard disks. Of course, if you want to get really unhappy, shop for hard disks for the Amiga.

System Saver Mac

Another gadget I bought at the sale was the System Saver Mac from Kensington Microware Ltd. This is a combination power conditioner, switching unit, auxiliary power outlet, and fan for the Macintosh. It sits on top in the "carrying handle" groove; you plug the Mac, hard disk drive, and whatever else you want to power up with the Mac into the System Saver Mac; there are two switches, so you can turn on the hard disk drive first, then the Mac.

I don't know what Apple has against fans. I'm told that Steve Jobs hated them, and although he wasn't in the habit of explaining himself, he once said that fans were noisy and drove away customers. It may be true, but the System Saver Mac's fan makes a nice little breeze, and even on a quiet night, it's not loud enough to bother me; in fact, it's not as loud as the AST-2000 hard disk drive, and that's very quiet.

I am also told by one of the original Macintosh development engineers that the designers were concerned about heat from the internal drive motor. My friend suggested that they extend the drive shaft and put a fan blade on the end. That way they'd get some air circulation during disk access, and it sure wouldn't add to the noise. When he told his idea to Jobs, the reply was an adamant "no," with no discussion. I suppose there are all kinds of management styles.

I don't know if the Macintosh Plus needs power conditioning and a fan, but the convenience of having multiple switched outlets was worth the sale price; and surely the fan can't hurt.

Mac II Blues

I'm told by reliable sources that the Mac II has a real problem: it strictly enforces the Mac programming standards. What makes that a problem is that much of the interesting Macintosh software was written by people who found the standard way

of doing things far too slow and made "improvements."

Among these programs, they tell me, is Microsoft's Excel, which is the program Apple hopes will boost the Mac into a serious contender in the business world.

Incidentally, one of the best tests of Macintosh standards is, of all things, Dave Small's Magic Sac cartridge for the Atari ST. If software runs on a Magic Sac, it will run on the Mac, Mac II, and anything else that enforces those standards.

How to Bore Your Customers

One of the potentially best games I've received recently is Epyx's Sub Battle Simulator for the Macintosh. This thing is a lot of fun, or could be. The action is exciting, and the play levels are well-graduated so that you can start at a low level and work up. There are lots of missions, and you can even do a full World War II campaign (as either a U.S. or a German submarine commander).

There's only one problem. The game tries to be a simulation, and all too often it succeeds.

In one sense, it's not a very good simulation: your sub, on the surface at least, is just too powerful against aircraft. There are other things you can do in the game that would have been absurd in real combat. That, however, isn't the problem, because all those glitches make the game more exciting.

No, the difficulty is that for a great deal of the time in the real world, submarine duty is dull; and Epyx has simulated *that* all too well. If you play the game in real time, you will spend hours and days going from one place to another with literally nothing happening. Actually, lookouts can report "Smoke on the horizon" from ships up to 400 miles away, which is pretty good smoke, so that you will see more things than a real sub commander would; but nowhere near enough. Long trips are a crashing bore.

Epyx's remedy for that is a speedup: you can make a second of real time equal to 1, 5, or 30 seconds of game time; 10 minutes of game time; and 4 hours of game time. There is also a "navigator" function that you can invoke: put in latitude and longitude, and the program will "sail" you there.

Alas, neither of those works very well. If you use the navigator, about one time in six, you will find you have navigated onto a reef, or an island, or, in one case, about 50 miles inland; and when the game drops into real time, it instantly tells you that you've destroyed the sub. The time-speed thing isn't much better, and, again, it very often does you in just after you've completed several missions.

I suppose the game designers think of this as "realism"; you shouldn't be using the 4-hours/second capability unless you're very watchful. Whatever they think, I think it's boring to spend a lot of time going from one place to another.

Epyx isn't the only one with that problem. I have a (not yet released) Star Trek game for the Atari ST that has the greatest graphics I've ever seen, terrific action, a quest, and some interesting strategic puzzles; but, alas, you have to travel from one star system to another (on warp drive) and from one planet to another (on impulse drive, and in Hohman minimum-energy orbits yet; as if a starship couldn't move in hyperbolic orbits).

If you go at a high game speed, you will damage the ship. If you go at a more reasonable game speed, it takes a lot of *real time*, and, once again, you are sitting there waiting and waiting and waiting for something to happen, only in the game nothing *can* happen while you're moving from one place to another. I eventually

continued

gave up on the game because I got so bored with the time required to travel.

My son Phillip found that David Joyner's Faery Tale Adventure (game of the month last month) has much the same problem: eventually your character gets so powerful that no one can harm him, but he has to spend literally hours—in real time—going from one place to another. This gets dull fast.

The moral of this story is that if you're going to design simulation games, think of them as *games* as well as simulations.

Flash: I've just received a new copy of Sub Battle Simulator that fixes the navigator bug and adds some new features. This turns a boring simulation into an exciting game. I'm glad somebody listens.

Case Closed

Another thing we got at the Priority One sale was a ProModem 1200B/2 300-/1200-bit-per-second modem for Mrs. Pournelle's AT&T 6300 Plus. What happened was that I had put the half-card OmniTel 2400 modem in Fast Kat the Kaypro 386, and the old full-card OmniTel 300/1200-bps modem into her machine. I'd used that modem for two years with no problem, but lately it had started doing odd things, and the line noise was not too good. When we got it into the 6300 Plus, it got worse.

I'm sure OmniTel would have fixed it, or even replaced it with the half-card they ship now, but the Priority One sale price was good, and Roberta was eager to get working on the education conference she now moderates on BIX; so I bought the ProModem.

The ProModem comes with SoftKlone's Mirror communications program, which is pretty well a dead ringer for Crosstalk. Roberta was already using Crosstalk and had all her Crosstalk scripts and such set up; it seemed reasonable that all we'd have to do was set the ProModem to port 2 and turn things on. One day I ought to test Mirror, but Crosstalk ain't broke, so why fix it?

Anyway, it took about 3 minutes to install the modem.

Then it was time to close the AT&T 6300 Plus case.

I will never understand AT&T. They have some of the greatest development engineers and scientists in the world at Bell Labs, and their regular troops aren't too shabby either; yet with all that talent, they turn their computer design over to Olivetti. Not *all* the design, of course. The actual innards of the AT&T 6300 Plus was Project Safari at Bell Labs. That part works fine. The 6300 Plus is a good machine, with CGA better than most people's EGA, and it has lots of neat features. It remains Roberta's Attila the Honey, and she loves it. On the other hand, the case must have been designed by a demented tinker.

Now certainly the IBM PC case can be improved on. A number of clone makers have done just that and furnish a tilt-up case. On the other hand, the standard PC case is "good enough"; you take out a few screws, pull the case off, and that's that.

The 6300 Plus is different.

To remove the cover, you have to take out only two screws. Then you sort of jiggle and pull, and the case comes off easily enough, although it doesn't just pull straight back. When it comes to getting the 6300 Plus's cover on again, though, you have a fight on your hands. At least I did: it took me just about half an hour, at the end of which I was cursing the designer, his professors, his parents, and everyone else involved in that madman's birth and education.

I won't attempt to describe the latching system on the 6300 Plus. Suffice it to say that assembling children's toys of the "Insert tab A into slot B" variety on Christmas Eve is literally child's play compared to getting all four of the lid's oddly shaped tabs to lock simultaneously onto the case body. It can be done, but be prepared.

I don't know who designed that case, but I'd hate to think they'll let him work on anything else. In fairness, I should say that Paul Chisholm of AT&T says it takes him only 30 seconds to put the top on—and if I wanted a modem, why in heaven's name didn't I call AT&T?

The ProModem works fine, though. Roberta didn't change her software at all, and now she's got a lot less line noise.

CompareRite

People are always looking me up at computer shows to tell me about a program that I simply must have. Most of the time I either already have a program to do whatever it is theirs does, or it's clear that the Inferno will run out of coal before I need *that* program; but sometimes I get a pleasant surprise.

CompareRite is one of the latter cases. It's an advanced program to compare two versions of a file and make a composite third version that has the original with the text deleted in the second version marked in one way and text inserted by the second

continued

THE PROGRAMMER'S SHOP

helps save time, money and cut frustrations. Compare, evaluate, and find products.

RECENT DISCOVERY

HUMMINGBOARD 386-Develop 2.6 or 7.9 times faster than a 8 MHZ AT. AT or XT addin board uses dual processors for Speed and Hardware Debugging. 16 MHZ or 20 MHZ. Call about Benchmarks, Trial Program.

AI-Expert System Dev't

Arity Combination Package	PC	$ 979
System - use with C	MS	$ 229
SQL Dev't Package	MS	$ 229
Auto-Intelligence	PC	$ 739
CxPERT - shell for C	MS	$ 295
Experteach - Powerful, samples	PC	$ 339
Exsys	PC	$ 289
Runtime System	PC	$ 469
Level 5	MS	$ 659
Intelligence/Compiler	PC	$ 739
T.I.: PC Easy	PC	$ 435
Personal Consultant Plus	PC	$2589
Personal Consultant Runtime	PC	$ 85
Turbo Expert-Startup(400 rules)	PC	$ 129
Corporate (4000 rules)	PC	$ 359

AI-Lisp

Microsoft Lisp V5.1	MS	$ 159
PC Scheme LISP - by TI	PC	$ 85
Star Sapphire	MS	$ 459
TransLISP - learn fast	MS	$ 79
TransLISP PLUS	MS	$ 125

Others: IQ LISP ($239), IQC LISP ($269)

AI-Prolog

APT - **A**ctive **P**rolog **T**utor - build applications interactively	PC	$ 49
ARITY Prolog - full, 4 Meg		
Interpreter - debug, C, ASM	PC	$ 229
COMPILER/Interpreter-EXE	PC	$ 569
Standard Prolog	MS	$ 77
MacProlog Complete	MAC	$ 269
MicroProlog - Prof. Entry Level	MS	$ 85
MicroProlog Prof. Comp./Interp.	MS	$ 439
MPROLOG P550	PC	$ 175
Prolog-86 - Learn Fast	MS	$ 89
Prolog-86 Plus - Develop	MS	$ 199
TURBO PROLOG by Borland	PC	$ 69

Basic

BAS_C - economy	MS	$ 179
BAS_PAS - economy	MS	$ 135
Basic Development System	PC	$ 105
Basic Development Tools	PC	$ 89
Basic Windows by Syscom	PC	$ 95
BetterBASIC	PC	$ 129
Exim Toolkit - full	PC	$ 45
Finally - by Komputerwerks	PC	$ 85
Mach 2 by MicroHelp	PC	$ 55
QBase - screens	MS	$ 79
QuickBASIC	PC	$ **69**
Quick Pak-by Crescent Software	PC	$ 59
Stay-Res	PC	$ 59
True Basic	PC	$ 79
Turbo BASIC - by Borland	PC	$ 69

FEATURE

dB2C Toolkit V 2.0 by Software Connection. 220+ dBIII functions in C source, file handler, windowing, interface to db__VISTA, c-tree, dBCIII, MS, Lattice, Instant C. No Royalties MS $ 289

700+ Programmer's Products

The Programmer's Shop carries every programmer's software product for MSDOS, PCDOS, CPM, Macintosh, Atari, and Amiga systems. We help you choose the best tools for you. Most popular products are in stock, available for quick delivery. We will gladly special order a product for you at no charge — just allow a few extra days for delivery.

Need Cross Compilers, Translators, or the right Fortran compiler? Ask us.

Our Services:

- Programmer's Referral List
- Compare Products
- Help find a Publisher
- Evaluation Literature FREE
- Dealers Inquire
- Newsletter
- Rush Order
- *Over 700 products*

• BBS - 7 PM to 7 AM 617-826-4086 National Accounts Center

C Language-Compilers

AZTEC C86 - Commercial	PC	$499
C86 PLUS - by CI	MS	$359
Datalight C - fast compile, good code, 4 models, Lattice compatible, Lib source. Dev'rs Kit	PC	$ 77
Datalight Optimum - C	MS	$ 99
with Light Tools by Blaise	PC	$168
Lattice C - from Lattice	MS	$269
Let's C Combo Pack	PC	$ 99
Microsoft C 5.0- Codeview	MS	$**275**
Microsoft Quick C	MS	$ 69
Rex - C/86 by Systems & Software - standalone ROM	MS	$695
Turbo C by Borland	PC	$ 69

C Libraries-Files

C Index by Trio/PLUS	MS	$319
BTree by Soft Focus	MS	$ 69
CBTREE - Source, no royalties	MS	$ 99
CTree by Faircom - no royalties	MS	$315
rtree - report generation	PC	$239
dbQUERY - ad hoc, SQL-based	MS	Call
dbVISTA - pointers, network.		
Object only - MSC, LAT,	C86	Call
Source - Single user	MS	Call
dBx - translator to library	MS	$299

C-Screens, Windows, Graphics

C Worthy Interface Lib.	PC	$249
Curses by Aspen Scientific	PC	$109
dBASE Graphics for C	PC	$ 69
ESSENTIAL GRAPHICS - fast	PC	$185
FontWINDOW/PLUS	PC	$229
GraphiC - new color version	PC	$279
Greenleaf Data Windows w/source	PC	$159
	PC	$289
Light WINDOWS/C-Datalight C	PC	$ 79
TurboWINDOW/C - for Turbo C	PC	$ 79
Windows for C - fast	PC	$189
Windows for Data - validation	PC	$319
Vitamin C - screen I/O	PC	$159
View Manager - by Blaise	PC	$199
ZView - screen generator	MS	$139

Atari ST & Amiga

We carry full lines of Manx & Lattice.

Call for a catalog, literature and *solid* value

800-421-8006

THE PROGRAMMER'S SHOP ™

Your complete source for software services and answers

5-B Pond Park Road, Hingham, MA 02043
Mass: 800-442-8070 or 617-740-2510 8/87

RECENT DISCOVERY

XENIX 386 Toolkit by Santa Cruz. Tools & OS kernel support 4 Gigabyte address space, demand paging, virtual memory paging. Includes MS C, MASM, debugger, file utilities, link kit, runtime library. PC $379

dBASE Language

Clipper compiler	PC	$399
dBASE II	MS	$329
dBase III Plus	PC	$429
dBASE III LANPack	PC	$649
DBXL Interpreter by Word Tech	PC	$139
FoxBASE+ - single user	MS	$349
Quicksilver by Word Tech	PC	$439

dBASE Support

dAnalyst	PC	$ 89
dBase Tools for C	PC	$ 65
dBrief with Brief	PC	Call
dBC ISAM by Lattice	MS	$169
Documentor - dFlow superset	MS	$229
Genifer by Bytel-code generator	MS	$279
QuickCode III Plus	MS	$239
R&R Report Generator	MS	$139
Seek-It - Query-by-example	PC	$ 79
Silver Comm Library	MS	$139
Tom Rettig's Library	PC	$ 79
UI Programmer - user interfaces	PC	$249

Fortran & Supporting

50:More FORTRAN	PC	$ 95
ACS Time Series	MS	$465
I/O Pro - screen development	PC	$129
MS Fortran - 4.0, full '77	MS	$279
No Limit - Fortran Scientific	PC	$109
PC-Fortran Tools - xref, pprint	PC	$165
RM/Fortran	MS	Call
Scientific Subroutines - Matrix	MS	$129

Multilanguage Support

BTRIEVE ISAM	MS	$185
BTRIEVE/N-multiuser	MS	$455
GSS Graphics Dev't Toolkit	PC	$375
HALO Development Package	MS	$389
Graphics	PC	$205
Hi-Screen XL - Lotus-style menu, windows	PC	$119
Informix 4GL-application builder	PC	$789
Informix SQL - ANSI standard	PC	$639
NET-TOOLS - NET-BIOS	PC	$129
Opt Tech Sort - sort, merge	MS	$ 99
PANEL	MS	$215
Pfinish - by Phoenix	MS	$229
Polyboost - speed I/O, keyboard	PC	Call
Prime Factor FFT - 8087/287	PC	$145
PVCS Corporate or Personal	MS	Call
QMake by Quilt co.	MS	$ 79
Report Option - for Xtrieve	MS	$109
Screen Sculptor	PC	$ 89
SRMS - new version	MS	$159
Synergy - create user interfaces	MS	$375
Xtrieve - organize database	MS	$199
ZAP Communications - VT 100	PC	$ 89

FEATURE

RTC PLUS by Cobalt Blue. Translate FORTRAN 77 and RATFOR to C except F77I/O, FORTRAN character, and complex expressions. Some DEC F77 extensions. Library C Source. MS $279

Note: All prices subject to change without notice. Mention this ad. Some prices are specials. Ask about COD and POs. Formats: 3" laptop now available, plus 200 others. UPS surface shipping add $3/item.

Circle 219 on Reader Service Card

version marked in another way. This makes it very easy to see what changes have been made.

CompareRite runs on a PC and works with most text editor formats. In my case, I use the CompuPro ARCNET PC board to transfer stuff from the ancient CP/M system I use for writing to the Kaypro 386 and do the comparisons there. It takes almost no time.

CompareRite is easy enough to learn and use. The menu system is a little tedious, but there's a command interface to shortcut it. The program is very speedy, and if you don't like the conventions it uses for marking insertions and deletions, there are options to let you change them.

If you write collaborations, it's obvious what you'd use this for. The manual has other suggestions. Editors can leave notes in text for authors; the notes will show up nicely. Merge versions of program documentation to make sure nothing is left out. Annotate stuff for yourself.

The program does *not* do something I badly want. I'd like to be able to open two versions of a file; have the program write to a third file everything that's common to both; and, where there are differences, show me in two windows the two versions, giving me a chance to choose the one that will be written to the output file. That way, I make a composite file of the best of both. So far as I know, though, there is no program that does that.

Otherwise, CompareRite does almost everything you'd expect a text comparison program to do. It's been added to my hard disk as a permanent working tool. Recommended.

The Write Dilemma

I'm still writing on Ezekial, the CompuPro CP/M Z80, but that can't last. There are just too many conveniences, like SideKick and Ready!, for PCs and PC-compatible machines. I already write just about everything but novels and BYTE columns on the PC anyway. Old machines were much slower than Zeke, but the Kaypro 386 may even be a bit faster; and the 19-inch Intecolor Megatrend EGA monitor gives me all the advantages of size, crisp text, and speed. In a word, it's a little silly to keep this enormous old Z80 "boat anchor" in addition to all my other equipment.

The only thing stopping me is that once I make a firm decision it will be nearly irrevocable, because my partner Larry Niven will then go out and buy an exact duplicate of my hardware and software. Actually, he'll buy *two* exact duplicates of my setup on the theory that the best maintenance policy is a second system.

continued

THE PROGRAMMER'S SHOP

provides complete information, advice, guarantees and every product for Microcomputer Programming.

PVCS

The Most Powerful & Flexible Source Code Revision & Version Control System

The POLYTRON Version Control System (PVCS) allows programmers, project managers, librarians and system administrators to effectively control the proliferation of revisions and versions of source code in software systems and products. PVCS is a superb tool for programmers and programming teams. (A special LAN version is also available.) If you allow simultaneous changes to a module PVCS can merge the changes into a single new revision. If the changes conflict, the user is notified. Powerful capabilities include: Stores and retrieves multiple revisions of text; Maintains a complete history of revisions to act as an "audit trail" to monitor the evolution of a software system; Maintains separate lines of development or "branching"; Provides for levels of security to assure system integrity; Uses an intelligent "difference detection" to minimize the amount of disk space required to store a new version. Requires DOS 2.0 or higher. Compatible with the IBM PC, XT, AT and other MS-DOS PCs.

	Sug. Retail	Prog. Shop
Personal PVCS		
—For single-programmer projects	**$149**	**$109**
Corporate PVCS		
—For larger, multiple-programmer projects	**$395**	**$309**

Call POLYTRON at (503) 645-1150 for pricing on larger networks

POLYTRON

Circle 221 High Quality Software Since 1982

NEW! From Sterling Castle...

BASIC Development Tools™

Powerful "Automatic Programming" Tools That Save You Hours of Valuable Time.

The novice or power programmer, can easily add these professional features.

- **Screen Builder**
- **B+ Tree**
- **EZ Screen Pop-up Windows**
- **Help Message System**

BASIC Development Tools™ (BDT™) is compatible with the newest, fastest compilers, including Microsoft QuickBASIC™ and Borland Turbo Basic.™ In BDT you have four powerful aids that can be used separately or together.

Screen Builder System translates the painted screen image into BASIC code which then can be merged in your program.

B+Tree Data Manager is a very fast data file index system providing both direct and sequential access to data. Complete source provided.

EZ Screen Pop-up Window Manager, written in assembler, easily inserts menus, windows, notepads. Saves a portion of the screen to/from a buffer.

Help Message System allows the creation of context sensitive help messages in your application program.

With BDT you have four of the most popular programming aids for **$99.00**. Includes two diskettes and 220 page manual.

60 DAY FREE TRIAL.
ORDER TODAY! (800) 722-7853
(213) 306-3020 in California

STERLING CASTLE™
Sterling Castle, 702 Washington St., Suite 174, Marina del Rey, CA 90292

All trademarks acknowledged.

Circle 222

Getting started in expert system development has never been this *Easy*

Announcing the Personal Consultant™ Series, from Texas Instruments. Now there's a family of powerful expert system development tools to get you started and keep you going.

Personal Consultant *Easy* (PC *Easy*) runs on select members of the TI Professional and IBM® Personal Computer families or compatibles. Designed for those just getting started in expert system development, PC *Easy* is the low-cost, high-functionality tool for rapid prototyping and development of expert system applications on personal computers for only $495.*

Personal Consultant *Plus* (PC *Plus*), the larger, more powerful member of the Personal Consultant Series, is priced at $2,950.* Designed to take advantage of today's more powerful AT-class of personal computers, PC *Plus* provides extended knowledge representation features; increased rule capacity; and access to the Lisp language allowing sophisticated developers the flexibility to extensively customize their applications.

Both microcomputer products feature a powerful rule entry language with integrated window-oriented editor; comprehensive user explanation facilities such as WHY, HOW, HELP, and REVIEW; support for TI and IBM EGA graphics; access to external information through DOS files or dBase™ inquiries; and the ability to deliver cost-effective versions of your applications with the addition of an optional run-time diskette.

Knowledge bases created using PC *Easy* are 100% upwardly compatible with the higher functionality PC *Plus* product on a microcomputer, allowing you to "get started and keep going" with total confidence that your software investment will be preserved.

PC Easy	**$ 439**
PC Plus	**$2599**

TEXAS INSTRUMENTS

*TI List Price, subject to change without notice.
Personal Consultant and Explorer are trademarks of Texas Instruments Incorporated.
IBM is a registered trademark of International Business Machines Corporation.
dBase is a trademark of Ashton-Tate.

©1986 TI 261765-04A

Circle 223

NEW C SAMPLER™ from Greenleaf Software.

The leader in C Programmer's tools.

This newly released 3 in 1 library contains 112 power packed functions from The Greenleaf Comm Library, Greenleaf DataWindows and The Greenleaf Functions. You get all the experience of the proven market leader, Greenleaf. And, until November 15, you'll also receive a

Free Source Code

with every C Sampler purchased.

INCLUDES:	SUPPORTS:
• Interrupt Communications	• Borland Turbo C • Microsoft Quick C
• Logical Windows	
• Pull-Down Menus	
• Intelligent Keyboard	
• Time/Date Functions	

List Price: $94.50
PS Price: $75.00

GREENLEAF Software©

Greenleaf Software, Inc.
16475 Dallas Parkway, St. 570, Dallas, TX 75248
Call Toll Free: 800-523-9830
In Texas & Alaska 214-248-2561

Circle 224

Call Today for FREE detailed information or try Risk-Free for 31 days, any product on this page.

800-421-8006

THE PROGRAMMER'S SHOP™
Your complete source for software, services and answers
5-B Pond Park Road, Hingham, MA 02043
Mass: 800-442-8070 or 617-740-2510 8/87

Every time I'm about to choose a text editor, someone improves a rival.

He will then expect things to be stable for a few years.

The hardware isn't a real problem. Given that you can afford it, a 386 with a couple of megabytes of 32-bit memory, DataDesk's Turbo-101 keyboard, and the Megatrend monitor will be fast enough and good enough for some time to come, and there's already plenty of auxiliary software, with more being written every day.

The problem is the text editor. Writers spend more time with that than anything else; and every time I'm about to choose one, someone improves a rival.

I'd about decided on WordPerfect, when Symantec came out with Q&A Write. This is an enhanced stand-alone version of the editor that comes with the Q&A database. It's simple to learn and easy to use. There's a little card-file database and mail-merge capability, and it's easy to communicate with standard Q&A. Q&A Write comes with the Oasis spelling checker; I use the CP/M version of that now, and I like it. You get a coupon for a discount on the Microlytics Word Finder Thesaurus, and that's got 220,000 words and is about the best thesaurus program in existence—incredibly speedy.

There are a bunch of other features to Q&A Write, many of them added at my suggestion.

There are a couple of missing features I'd like, things like delete to end of line in addition to delete line; but Q&A Write has the WordStar delete commands, like Control-T for delete word, and even better, unlike WordStar, Q&A Write reformats the text automatically. I do wish they'd give me the option of eliminating the Tabset and Status lines; I don't like anything on the screen I didn't put there.

Meanwhile, there's WordPerfect, which is darned good and does have simple ways to delete chunks of text. I am still not happy with the way WordPerfect moves text, saves and deletes marked segments, and generally handles blocks of text. Q&A Write does that much better, or at least it looks that way to me. Still, WordPerfect is a good professional writer's tool, and they keep updating and adding features as I suggest them. If Symantec makes no more improvements, I'll stay with WordPerfect. Especially now that there's Mouse Perfect.

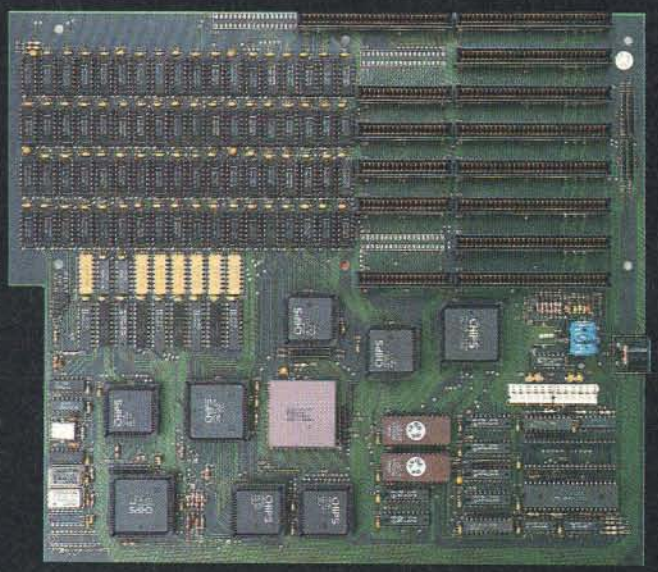
One complaint I've had about WordPerfect is that it doesn't recognize mice. Now true: the reason I don't like Microsoft Word is that the mouse is such an integral part of the program. When I'm creating text, I do *not* want to take my hands off the keyboard to delete words and lines by marking with mouse tracks (or arrow keys, for that matter). However, when I'm editing already-written stuff, I do like the convenience of using the mouse to get rapidly from one place to another, and mouse-driven menus can be useful.

Mouse Perfect adds that capability to WordPerfect.

When you use Mouse Perfect with WordPerfect, a click on the middle button of the Logitech LogiMouse (or on the Microsoft two-button job, both buttons at once) brings up a menu of things WordPerfect can do, like `SAVE`, `SPELL`, `COPY`, `CUT`, and `DELETE`. Clicking the mouse on one of those menu items either does the

continued

TURN-POINT AMERICA



386 Motherboard $1495

- 16 Mhz 80386 cpu
- Up to 2 Mb memory on board
- 2 XT expansion slots
- 5 AT expansion slots
- 1 32 bit or AT slot
- AT size board
- 80287 socket on board
- Fully AT compatible

LCD Portable Case $795

- Full 80 x 25 LCD tilt-out display
- Display board with printer port included
- Emulates CGA or MDA
- Accepts two 5¼" half height drives
- Full function XT or AT keyboard
- 150 watt power supply
- Accepts XT or Baby AT motherboards
- Accepts full height AT boards
- Case Dimension 8" x 9½" x 15¾"

a. Baby AT Motherboard w/0k $380.00
- 100% IBM AT compatible
- 10 Mhz at Zero wait states
- XT board size and mounting holes
- Built in serial port on board
- Setup programs included

b. Top-Net Local Area Network Board $249.00
- 1 Mbit/sec data rate
- Up to 4000 ft. cable length
- Up to 64 stations
- Optional IBM Network and Novell drivers

Starter kit includes (call for price)
- 2 Network boards
- Complete software and manual
- 30 ft. twisted pair cable

c. Ram-Master Expansion Memory Board w/0k $85.00
- Up to 2 Mb of expansion memory
- Full Lotus/Intel compatibility
- User configurable as conventional memory, expansion memory or both
- Software included supports 8 Mb on XT or AT

d. Mighty Mo 1200 Baud Internal Modem $79.00
- Full Bell and CCITT compatibility
- 100% Hayes command set compatibility
- Line quality monitoring and equalization
- Adaptive dialing
- Local/remote loop tests and self test

e. Ram-Master AT Multi-function w/0k $150.00
- Up to 3.5 Mb of extended memory for AT
- Up to 4 serial ports on board (1 installed)
- 1 Parallel port
- 1 Game port
- Ideal for multi-user applications

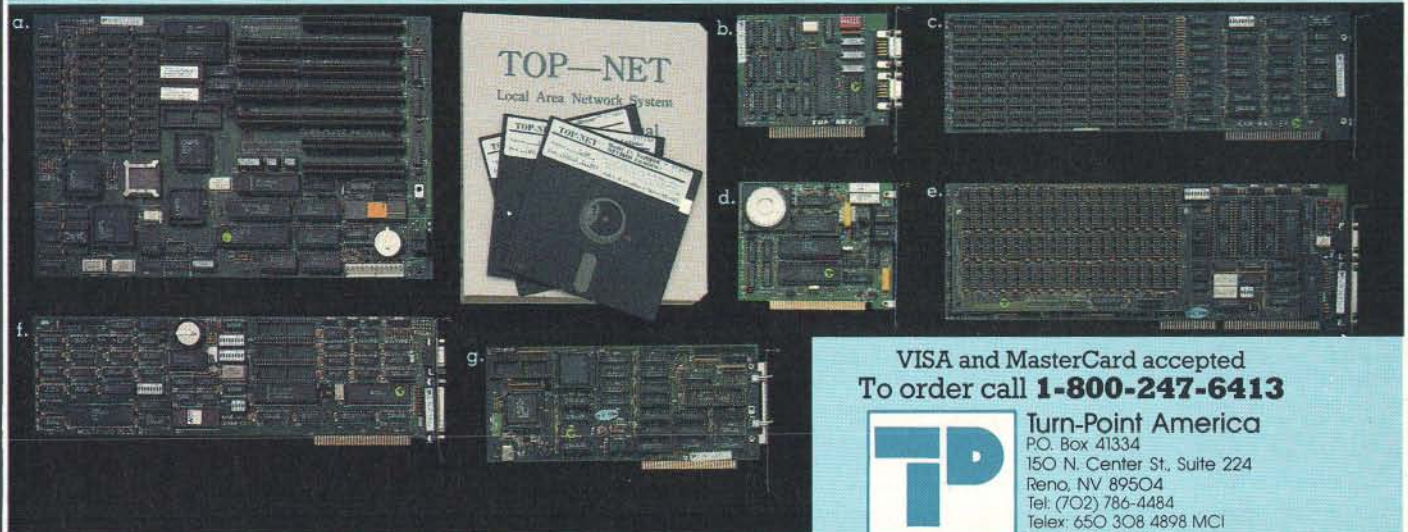
f. Multi I/O Plus for XT or AT $110.00
- Up to 4 serial ports (1 installed)
- 1 Parallel printer port
- 1 Game adapter port
- 1.2 Mb / 360k floppy controller
- XT version has battery backed-up clock

g. Accelerator 286 $250.00
- 10 Mhz clock speed
- 80286-10 CPU
- 80287 support at 5 or 10 Mhz
- 8k of zero wait state cache memory
- Switchable 8088 in system for compatibility

12 Mega-hertz Baby AT (not shown) **$395.00**
- 100% IBM AT compatible
- Setup program included

Ram-Master Plus Multi-function w/0k (not shown) **$125.00**
- All features of basic Ram-Master (item c)
- XT version has battery backed-up clock
- 2 Serial ports
- 1 Parallel printer port
- 1 Game adapter port

In addition to our own products, Turn-Point America is proud to offer the complete line of EVEREX Products plus hard drives and floppy drives at the lowest prices available.



VISA and MasterCard accepted

To order call **1-800-247-6413**

Turn-Point America
P.O. Box 41334
150 N. Center St., Suite 224
Reno, NV 89504
Tel: (702) 786-4484
Telex: 650 308 4898 MCI
Fax: (702) 826-6741

Turn-Point America products carry a one year warranty.

Circle 281 on Reader Service Card

command or gets you a new menu of options within that command. If you really know WordPerfect and can do finger exercises with Control-function keys and so forth, things may go faster if you don't use the mouse; but if you're still looking things up on the WordPerfect command list, the Mouse Perfect menu system is a lifesaver.

The menus are context-sensitive: there are about a dozen different command screens the mouse will show you, each appropriate to where you are within WordPerfect. The integration is very, very good.

Mouse Perfect won't work under DESQview. DESQview uses the mouse to create its own menu system; if you run the memory-resident Mouse Perfect in a batch file so that it's installed in the same window with DESQview, the result is to disable the mouse entirely; it won't work for *anything* until you kill that window.

The Mouse Perfect documents are terse, but written in English, and complete. It took me about 10 minutes to install Mouse Perfect and maybe another 10 in experiments to get comfortable with it. After that, I began to get dependent on it. I do wish it would run under DESQview, though. If you use WordPerfect and want a mouse, this is the program you need. Recommended.

I had literally just written the above when Dr. Gordon Eubanks, chairman of Symantec, stopped by to show me yet more features of Q&A Write. In particular, we looked into the different font cartridges I have for my Hewlett-Packard LaserJet Plus and noticed what's probably the best of the lot, the so-called Microsoft 1 92286Z. This has regular Courier; Times Roman 12-point in normal, bold, and italic; the same for Times Roman in 10-point type; a LinePrinter medium; and 8-point Times Roman medium; all in proportional spacing.

Q&A Write will support all of those, and we installed them; now I'm having fun playing about printing fancy manuscripts. I can certainly recommend that cartridge. Anyway, I showed Gordon the Mouse Perfect program. He ground his teeth and said they'd talk to the Mouse Perfect people about getting a version to work with Q&A Write or, barring that, implement something like it themselves. He also wrote down some other sugges-

continued

Items Discussed

AST-2000 ..... $1199
SixPakPremium
256K bytes $495
2 megabytes $1395
AST Research
2121 Alton Ave.
Irvine, CA 92714
(714) 553-0340

Bureaucracy $39.95
Infocom
125 Cambridge Park Dr.
Cambridge, MA 02140
(617) 492-6000

CompareRite $129.95
JURISoft Inc.
763 Massachusetts Ave.
Cambridge, MA 02139
(617) 864-6151

Gold Card 21 ..... $329
Silicon Valley Computer
140 Archer St.
San Jose, CA 95112
(408) 288-8837

High C
for MS-DOS $595
for 80386 ..... $895
MetaWare
903 Pacific Ave., Suite 201
Santa Cruz, CA 95060
(408) 429-6382

Hi-Res Graphics Card $219
Paradise Systems
217 East Grand Ave.
San Francisco, CA 94080
(415) 871-4939

Lattice C $500
Lattice Inc.
P.O. Box 3072
Glen Ellyn, IL 60138
(312) 858-7950

Microsoft C $450
Microsoft
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073-9717
(800) 426-9400

MotherCard 5.0 ..... $1095
Sota Technology Inc.
657 Pastoria Ave.
Sunnyvale, CA 94086
(408) 245-3366

Mouse Perfect $25
Mouse Perfect Inc.
P.O. Box 367
Clarkston, GA 30021
(800) 628-2828 ext. 564

pc-ditto $89.95
Avant Garde Systems
381 Pablo Point Dr.
Jacksonville, FL 32225
(904) 221-2904

ProModem 1200B/2
no software $199
with software $249
Prometheus Products Inc.
4545 Cushing Parkway
Fremont, CA 94538
(415) 490-2370

Q&A Write $199
Symantec
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600

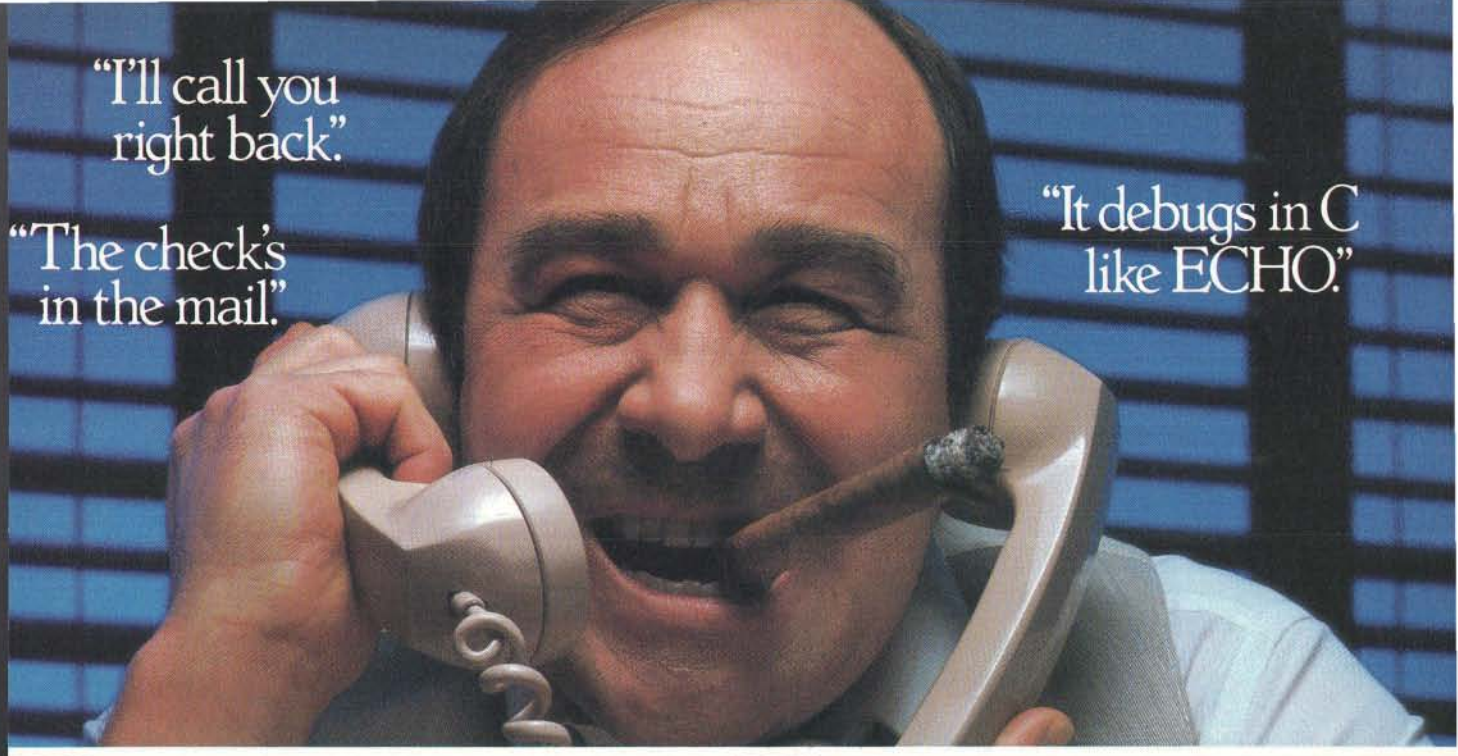
ST225 ..... $375
UPM150 ..... $55
Unitex Co.
657 North Pastoria Ave.
Sunnyvale, CA 94086
(408) 732-6264

Sub Battle Simulator $39.95
Epyx Games
600 Galveston Dr.
Redwood City, CA 94063
(415) 366-0606

System Saver Mac $99.95
Kensington Microware Ltd.
251 Park Avenue S
New York, NY 10010
(800) 535-4242

Turbo C $99.95
Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8400

Word Finder Thesaurus
for Macintosh $59.95
for IBM PC $79.95
Microlytics
300 Main St.
East Rochester, NY 14445
(716) 377-0130



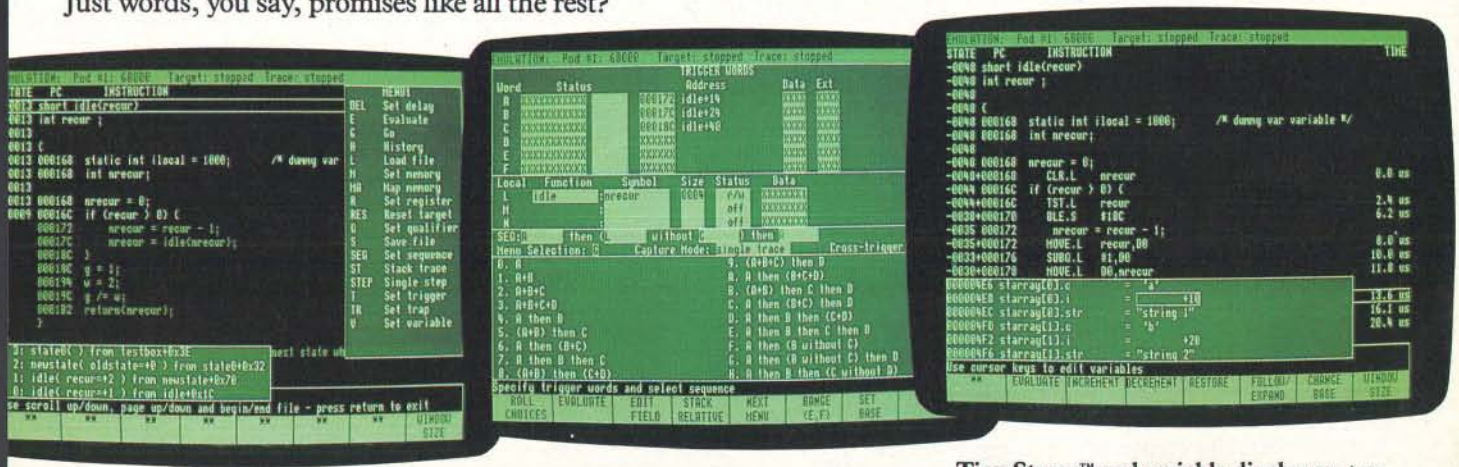
Promises, Promises.

Everybody promises, but nobody delivers a real-time, emulator-based C-debug environment like Arium's ECHO. 16-bit, true multitasking and UNIX-based, ECHO gives you more power, speed and menu-driven features to handle the 68000 and other μPs better than the HP 64000, or anything else.

Just words, you say, promises like all the rest?

Prove it to yourself. Read the screens below. Then ask any other development system—standalone or host control—to match them. We'll wait.

Now you know a few reasons (and there are plenty more) why ECHO should be your emulation tool for today's increasingly complicated software debugging.



Code Preview™ lets you see where your code is going. You can follow calls and branches (to 99 levels) on the screen, to select the source line on which to trigger, then set and break in one keystroke! The highlighted trace display (in source) and stack trace window show the path your program took.

Stack-Relative Trigger lets you trigger on the addresses and values of stack-relative variables—a "must" for effective C-debug where the address of an automatic variable is different each time the function is called and is determined at execution. Here, a read of the local variable "nrecur" is included in the trigger sequence.

TimeStamp™ and variable display are two further features that are a must for real-time C-debug. Note the display of two instances of a structure in array "starray." The contents of these structures, as for any C variable, can be changed right on the screen.

For a demonstration call
800/862-7486 (CA 714/978-9531)

ARIUM CORPORATION

1931 Wright Circle, Anaheim, CA 92806

Circle 20 on Reader Service Card (Dealers: 21)

The potential of C is so humongous that Microsoft and Borland have about declared war with C as a battlefield.

tions, like having Q&A Write count words, lines, and paragraphs automatically the way WRITE does.

I still haven't chosen a text-editing program, but I love it when a plan comes together.

The Great C Compiler War

I confess I never thought there'd be a big market for C compilers.

C is a language about half a step up from assembly language. It's possible to write structured comprehensible code in C, although I've seen little of it; it's also possible to write incomprehensible routines filled with strange tricks.

C has a large number of good points for those who spend a lot of time writing C code; but for part-time programmers like me, it's not the language of choice because it's very easy to forget how you did something in C, even if you thought you'd written plenty of comments. I feel particularly sorry for software publishing outfits if they lose the original programmer and have to bring in someone else to maintain C code.

Of course, C is *the* Unix wizard's tool, and it has got to the point where knowing C is often thought to divide the real hackers from the hangers-on. Even so, I'd never in a million years have suspected anyone could sell a hundred thousand copies of the language.

Apparently, though, the potential of C is so humongous that Microsoft and Borland have about declared war with C as one of the battlefields. (Compiled BASIC is another; this morning, I received version 4.0 of Microsoft QuickBASIC.)

Both would as soon ignore Lattice, which isn't as big as Microsoft or Borland but still has plenty of loyal supporters. Those are, though, the "Big Three" companies making C compilers for microcomputers.

Although I'm no C hacker, all three companies keep soliciting my opinion, and so have a lot of readers. Fair warning: this is an outsider's view. I've talked to a lot of people, users and compiler writers, and this is what I've come up with.

Turbo C from Borland is faster than the dickens, writes neat code, and is one heck of a bargain at a price of $99.95. Anyone who has the slightest interest in learning C, or even in learning a good bit *about* C, will want the Borland package; at that price, you can't afford not to have it. It's the clear choice for beginners and dilettantes.

The Borland integrated editor/environment looks and works pretty much like the Turbo Pascal environment, and it's plenty easy to learn. The Borland compiler looks and feels a lot like the long-known Wizard Compiler, and although Borland says they only bought Wizard talent, most hackers think there's a great deal of the Wizard in Turbo C; and since the Wizard Compiler always was a nice compiler, this is no bad thing.

Whatever your interest in C, if it's at all serious, you're likely to want to get Turbo C.

On the other hand, Microsoft C has Codeview, which is arguably the best debugger in microland. If you do much C hacking, it's worth having Microsoft C just to get the debugger. On the other hand, the Microsoft libraries were developed with one eye on Xenix, and Microsoft will never release the source code to those libraries.

Now comes Lattice. Lattice has libraries more in tune with MS-DOS; and you can get the library source code. Experienced C hackers tell me that for really humongous programs, the Lattice code is a bit more elegant; one even used the phrase "more stable" while hastening to add that he wasn't implying there were serious defects to the Microsoft code. Lattice doesn't have an integrated editor environment like Borland's, but then most hackers use command line anyway.

Microsoft has cross compilers for their C, but they don't necessarily release them; Lattice does.

So far, the conclusion seems to be that the Borland compiler is a great bargain for professionals and amateurs alike; but for big, hairy C jobs, the contest is between Microsoft and Lattice, and many programmers use both, switching back and forth as they need the Codeview debugger.

Comes now the dark horse. In addition to the Big Three, there's MetaWare's High C. This is a fairly expensive compiler that's enthusiastically recommended by some of the best known names in the industry, including Gordon Eubanks. There's no debugger for it; Eubanks uses the Phoenix PFIX and PLINK utilities.

MetaWare isn't a terribly well known company, but it has the most enthusiastically loyal customers I've seen in this industry. MetaWare code is particularly transportable, and they have compilers and code generators for just about everything from mainframes to Z80s and cross compilers for most. Much of the 386 version of Symantec's newest Q&A was done with a 386 version of the MetaWare compiler.

I have been shown a debugger Borland is developing that is better than Codeview; it's supposed to be out before the end of 1987 and will greatly strengthen the utility of Turbo C for big production jobs.

I refuse to draw any conclusions from all this. Every one of these compilers has enthusiastic support from people I respect.

Winding Down

I want to mention again Avant Garde's pc-ditto, which, so far as I can tell, runs *every* PC program on an Atari ST. Some of them run pretty slow, but they all run; the emulation is down to the chip level. If you have a 5¼-inch disk drive, you can even run copy-protected software. If you've got an Atari, you probably need this program.

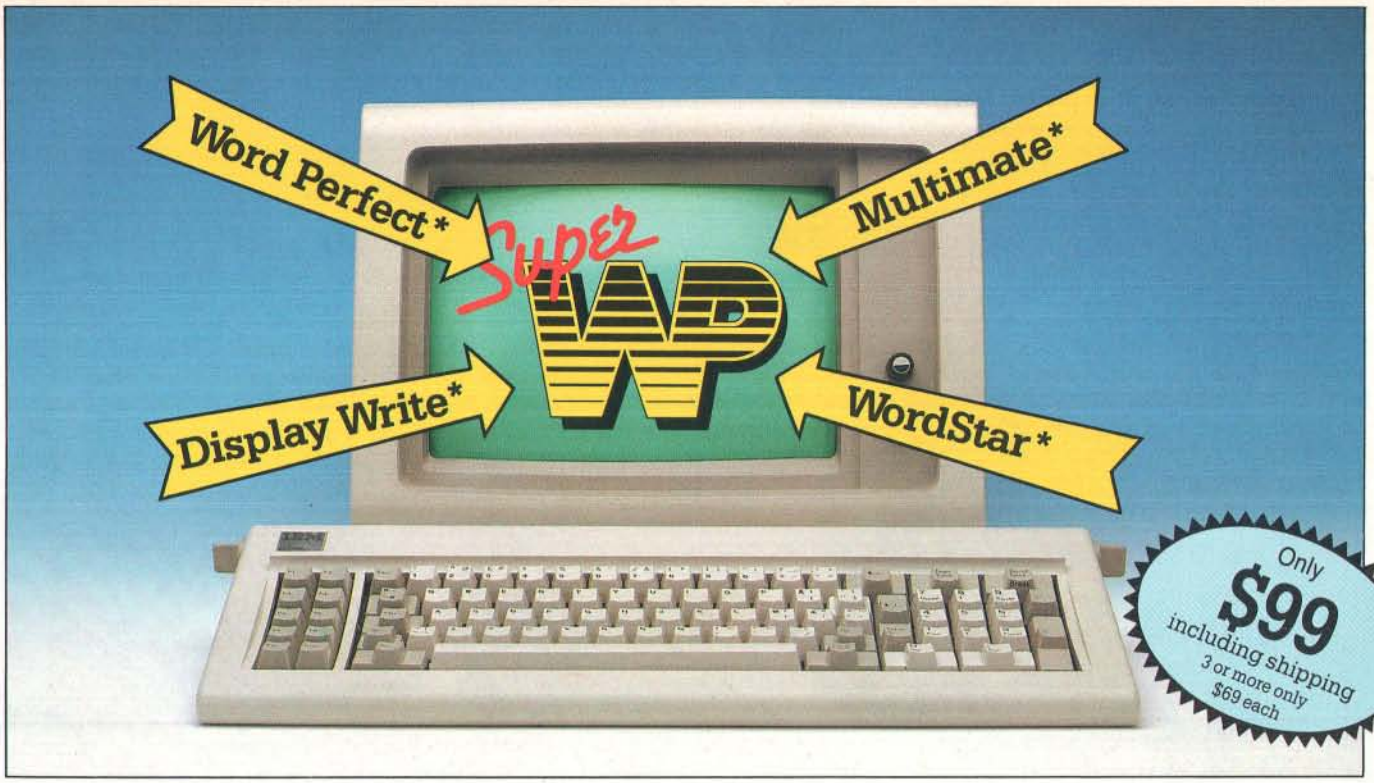
Another one I've set out for a look is OWL International's Guide, billed as "Hypertext for Personal Computers." I reviewed the Macintosh version of Guide a couple of months ago. Now they have one for the IBM PC. With luck, I'll get to that next month.

The game of the month is Infocom's Bureaucracy, written by Douglas Adams. Larry Niven got so engrossed with this thing that I had to help him—and ended up myself asking for help through BIX. One of its features is a flier for a magazine, *Popular Paranoia*, which every month gives you something new to worry about. Just be sure you don't eat the Zalagosian stew.

The book of the month is by C. J. Date, *An Introduction to Database Systems* (Addison-Wesley, 1987). This book has told me a great deal more than I wanted to know about databases; but it turns out I *did* want to know many things I never thought I had. This is not easy reading, but there's a lot of solid information.

A ton of new equipment came in today; I think I have a test bed for some of my other update and speedup PC boards. And now I'm off for the Westercon science fiction convention. ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.



Finally – the only universal Word Processor!

Following extensive development and numerous rumors in the market, Viking Research Inc. now have the pleasure of introducing the *Super WP.*

The *Super WP* is a «generator» for word processing, like DBASE III is in the field of applications-generations.

By following simple instructions, the *Super WP* enables you to define the characteristics of every type of the major word processor around; their keyboard-commands, screens, disk formats, etc. Of course, we have pre-defined for you the most well-known systems, like Word Perfect*, WordStar*, Display Writer* and MultiMate*.

You can choose between running these programs in Original mode (99 % compatible) – or in *Super Mode* with state-of-the-art Windows on all levels.

This means that any document written in, for example, Word Perfect*, or WordStar* can be handled by the *Super WP* – while enjoying the advantage of several new features.

The *Super WP* will provide you with the ability to cross-define standards. Many of us found the transition from good, old WordStar* to Word Perfect* troublesome and difficult – but with *Super WP,* this problem no longer exists. You just select the WordStar* standard for your keyboard and screen and the Word Perfect* standard for your disk output. Every user can then process the document whichever way that suits him best: as WordStar* or as Word Perfect* – saving everyone the frustration of having to «convert.»

The *Super WP* can even read documents written in WordStar* on the Osborne 1 and the Kaypro CP/M machines!

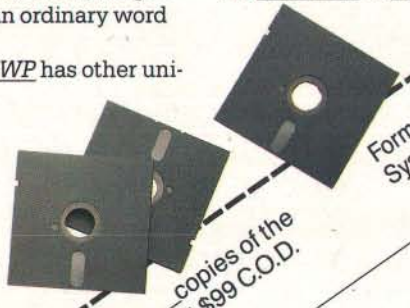
You choose between the different standards in a simple start-up program. When this initial configuration is done, the program then operates as an ordinary word processor.

In addition, the *Super WP* has other unique functions such as:

• Learning keyboards
• It allows for 16 fonts in printing • It can calculate proportional inter-word spacing for laser printers/matrix printers • It contains a Calculating Cursor, making your word processor appear as a simple spreadsheet • Contains sophisticated Windows functions • User-defined keyboards and disk output formats • It comes with a very user-friendly, 200-page manual
• And most importantly: the *Super WP* costs only $99! For this low price, you get all the latest in word-processing – plus full flexibility.

Some years ago, the introduction of PC-clones led to the price-revolution that has taken place in hardware. Now, we at Viking Research have taken the initiative in revolutionizing software, with our all-purpose word-processing clone.

Whether you are simply looking for a low cost editor, or you need a sophisticated all-purpose word-processor with excellent documentation – the *Super WP is it!*



Format: ☐ 5¼" ☐ 3½"
System: ☐ PC/MS-DOS ☐ QNX

Yes, send me ___ copies of the *Super WP* at $99 C.O.D.

Name:

Address:

City:

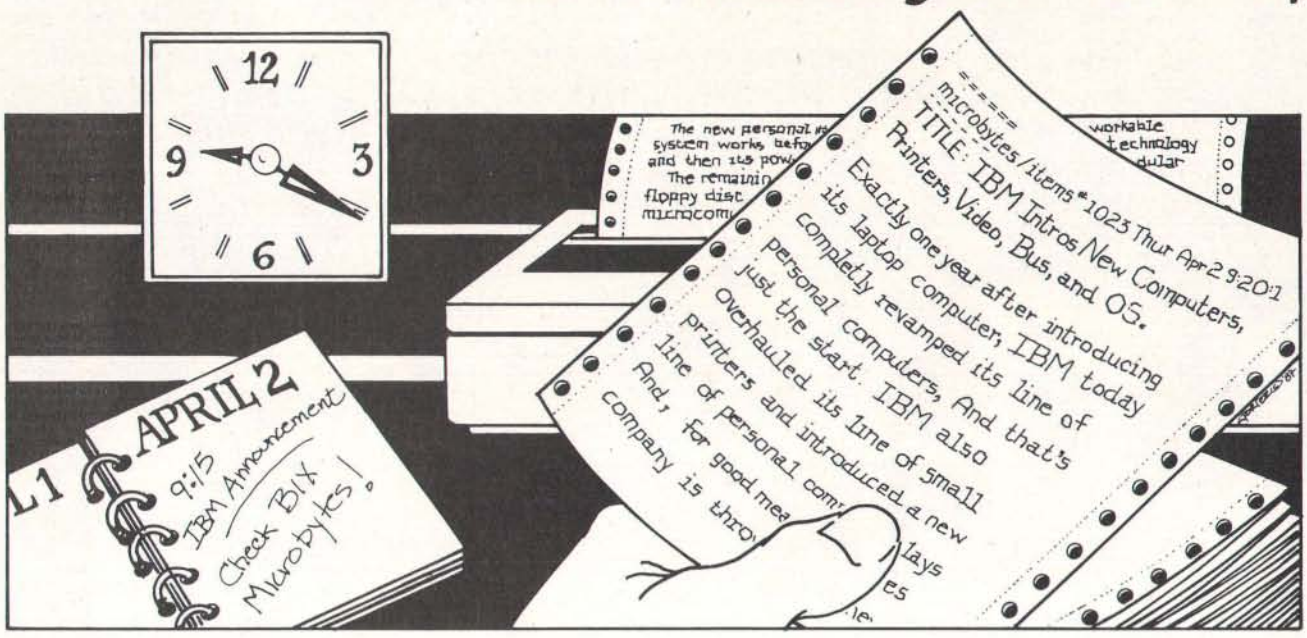
State/Zip:

VIKING RESEARCH INC.
4083 Avenue 216, Tulare, California 93274

* Display writer is a trademark of IBM Corp, WordStar is a trademark of Micropro Int. Corp., Word Perfect is a trademark of Word Perfect Corp., MultiMate is a trademark of Multi Mate Int. Corp.

Circle 205 on Reader Service Card

BIX Microbytes: One of



Timely and Detailed Computer-Related News and New Product Information Via Your Computer

—IBM unveils its new Personal System/2 Computers and OS/2 operating system. BIX begins providing detailed coverage to its 17,000 users worldwide, five minutes after the corporate unveiling.

—A spokesman for a major 386 chip manufacturer says the industry is turning to single-sourcing. BIX has the story and analysis, including a forecast of possible 386 chip shortages in the months ahead.

—Buyers of a major computer manufacturer's newest product report interface problems with some hard disk drives. BIX reports first on the problem and on the company's announcement of an update.

If information like this vital to you and to your company, you should know about Microbytes, one of six powerful services you get when you join BIX.

NEWS

Microbytes is a daily newswire of computer-related information, available to all BIX users. BYTE and BIX editors attend trade shows and press conferences, talk with industry leaders, researchers and product developers and scan thousands of press releases. Each day they file detailed reports, often exclusive, filled with information that's vital to you—new technologies and trends that will influence the products of the future, major speeches and events, acquisitions and more.

NEW PRODUCTS

Microbytes is new product information. BYTE and BIX staff analyze thousands of new computer-related products each month, and detail the most significant in specially organized hardware and software product listings.

DETAILED AND IN-DEPTH

Microbytes supplements BYTE's editorial coverage with additional articles, interviews and special product previews and reviews. You never miss important items because BIX remembers what you've read and takes you immediately to any new information posted since the last time you were on. And since important news is retained on-line, you can quickly locate past coverage of specific products or events using the powerful BIX search command.

Need more information? Call or write* BIX *and ask for the Microbytes Information Pack or circle number 425 on the* BYTE *Reader Service Card.

Join Microbytes Today

If you're unfamiliar with on-line services but interested in Microbytes, we've made things easy for you. Follow the procedures on the opposite page, but enter the word **micronews** in place of the word **new**. You'll be automatically joined to the free BIX learn conference (which teaches you how to use the system) and to Microbytes. (Other BIX services are yours whenever you want them. Once you've registered, BIX bills you only for the time you are connected . . . no minimum monthly charges or special fees.)

***BIX Microbytes is one of six powerful services available to you when you join* BIX.**

Circle 425 on Reader Service Card

Six great reasons to join BIX today

- **Over 140 *microcomputer-related conferences*:**
Join only those subjects that interest you and change selections at any time. Take part when it's convenient for you. Share information, opinions and ideas in focused discussions with other BIX users who share your interests. Easy commands and conference digests help you quickly locate important information.

- ***Monthly conference specials*:**
BIX specials connect you with invited experts in leading-edge topics—the IBM PS/2 family, OS/2, and more. They're all part of your BIX membership.

- ***Microbytes daily*:**
Get up-to-the-minute industry news and new product information by joining Microbytes.

- ***Public domain software*:**
Yours for the downloading, including programs from BYTE articles and a growing library of PD listings.

- ***Electronic mail*:**
Exchange private messages with BYTE editors and authors and other BIX users.

- ***Vendor support*:**
A growing number of microcomputer manufacturers use BIX to answer your questions about their products and how to use them for peak performance.

What BIX Costs. . How You Pay

ONE-TIME REGISTRATION FEE: $25

Hourly Charges: (Your Time of Access)	**Off-Peak 7PM–6AM** Weekdays Plus Weekdays & Holidays	**Peak 6AM–7PM** Weekdays
BIX	$9	$12
Tymnet*	$2	$8
TOTAL	**$11/hr.**	**$20/hr.****

* *Continental U.S. BIX is accessible via Tymnet from throughout the U.S. at charges much less than regular long distance. Call the BIX helpline number listed below for the Tymnet number near you or Tymnet at 1-800-336-0149*

** *User is billed for time on system (i.e., ½ Hr. Off-Peak w/Tymnet = $5.50 charge.)*

BIX and Tymnet charges billed by Visa or Mastercard. Call or write for other billing options.

BIX HELPLINE
(8:30 AM–11:00 PM Eastern Weekdays)
U.S. (except NH) and Canada—1-800-227-BYTE
Elsewhere (603) 924-7681

We'll Send You a BIX User's Manual and Subscriber Agreement as Soon as We've Processed Your Registration.
JOIN THE EXCITING WORLD OF BIX TODAY!

JOIN BIX RIGHT NOW:
Set your computer's telecommunications program for full duplex, 8-bit characters, no parity, 1 stop bit OR 7-bit characters, even parity, 1 stop using 300 or 1200 baud.
Call your local Tymnet* number and respond as follows:

Tymnet Prompt	**You Enter**
Garble or "terminal identifier"	a
login:	bix <CR>
BIX Logo—Name:	new <CR>

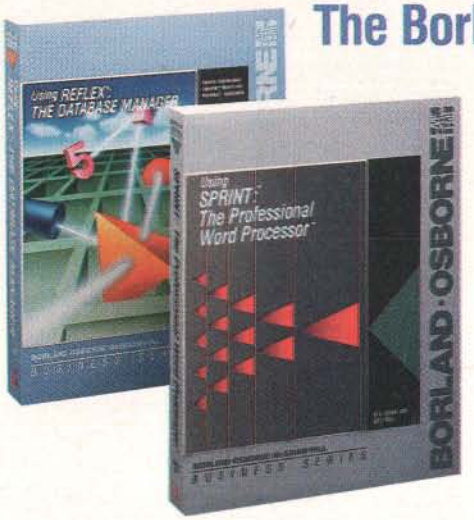
After you register on-line, you're immediately taken to the BIX learn conference and can start using the system right away.

FOREIGN ACCESS:
To access BIX from foreign countries, you must have a packet switching account with your local Postal Telephone & Telegraph (PTT) company. From your PTT enter 310600157878. Then enter bix <CR> and new <CR> at the prompts. Call or write us for PTT contact information.

BIX
ONE PHOENIX MILL LANE
PETERBOROUGH, NH 03458
(603) 924-9281

Circle 450 on Reader Service Card

Announcing
Two Dynamic New Imprints



The Borland-Osborne/McGraw-Hill Business Series

Using REFLEX®: THE DATABASE MANAGER
by Stephen Cobb
Features sophisticated SuperKey® macros and REFLEX Workshop™ applications.
$21.95 paperback, *ISBN 0-07-881287-9*

Using SPRINT™: The Professional Word Processor
by Kris Jamsa and Gary Boy
Take advantage of this fabulous new word processing system that is powerful, fast, and includes many desktop publishing features.
$21.95 paperback, *ISBN 0-07-881291-7*

The Borland-Osborne/McGraw-Hill Programming Series

Using Turbo C®
by Herbert Schildt
Here's the official book on Borland's tremendous new language development system for C programmers.
$19.95 paperback, *ISBN 0-07-881279-8*

Advanced Turbo C®
by Herbert Schildt
For power programmers. Puts the amazing compilation speed of Turbo C® into action.
$22.95 paperback, *ISBN 0-07-881280-1*

Advanced Turbo Prolog® Version 1.1
by Herbert Schildt
Now Includes the Turbo Prolog Toolbox™ with examples of spreadsheets, databases, and other business applications.
$21.95 paperback, *ISBN 0-07-881285-2*

Turbo Pascal® Programmer's Library
by Kris Jamsa and Steven Nameroff
Revised to cover Borland's Turbo Numerical Methods Toolbox™
$21.95 paperback, *ISBN 0-07-881286-0*

Using Turbo Pascal®
by Steve Wood
Featuring MS–DOS programs, memory resident applications, in-line code, interrupts, and DOS functions
$19.95 paperback, *ISBN 0-07-881284-4*

Advanced Turbo Pascal®
by Herbert Schildt
Expanded to include Borland's Turbo Pascal Database Toolbox® and Turbo Pascal Graphix Toolbox®
$21.95 paperback, *ISBN 0-07-881283-6*

Available at Book Stores and Computer Stores.
OR CALL TOLL-FREE 800-227-0900
800-772-2531 (In California)

In Canada, contact McGraw-Hill Ryerson, Ltd. Phone 416-293-1911

Osborne McGraw-Hill
2600 Tenth Street
Berkeley, California 94710

Circle 202 on Reader Service Card

BORLAND·OSBORNE/McGraw-Hill

Into the 4th Dimension, Part 1

Ezra Shapiro

First impressions of 4th Dimension on the Macintosh, E-mail updates, and more

This was going to be the month for 4th Dimension (Acius, $695), the new Macintosh database manager and application development system originally called Silver Surfer. It's an important product that will almost certainly be a major contender in the marketplace.

Unfortunately, it takes time to evaluate a relational database manager, particularly one that boasts full programmability and control of just about everything you'd ever need to control on the Mac, including the ROM Toolbox and serial-port access. Five weeks of intermittent testing have not been enough for me; at this point, I can only offer some preliminary reactions.

At first, I found myself mildly disappointed with the product. I had wanted 4th Dimension to be as easy to use as PFS:File on the IBM PC or Microsoft Works on the Mac, with the programmability of R:base or Paradox, and the flexibility of access to the Mac Toolbox—all without the need to learn programming syntax. Of course, this superprogram had to be faster than anything else out there.

By the time I received my copy from Guy Kawasaki, former Apple evangelist who now heads up Acius, I had heard so much gossip touting 4th Dimension as the best database manager ever sold that it couldn't possibly have lived up to my expectations. I think this is going to be a problem for the product for awhile, through no fault of the developers. The Mac community—perhaps the whole microcomputer universe—is so starved for a better way to manage data that any new package is going to fall short of hopes and dreams.

As a pure database manager, 4th Dimension is not as easy to bring up as some of the more elementary filing programs. Though you can start out immediately by defining fields for a new database (one of the things I loved about dBASE II), you have to design entry and report forms before you can begin to work with data.

The icons used within the program are not as cryptic as some I've seen (look at Helix if you want an example), but you might have some trouble figuring them out. To get anywhere at all, you simply must crack open the manuals and read about what's going on. So 4th Dimension is not as inviting to the novice as I had wished.

However, once I got the point, which is that 4th Dimension is a development environment, I lost my initial hesitation. The program is not intended as a tool for idiot users—it's a way to build applications for them, and it's extremely good at that.

You can code a program by writing in a stylized programming language, you can build routines by pulling procedures and operators from menus and dialog boxes, or you can even draw a graphic flowchart of an application and have 4th Dimension write the program for you. All the way through, you're in charge, and you can switch among forms of program creation as you desire. It's all very slick, and the program is exceptionally fast at realizing a completed project.

What if you're a single user who just wants to use the database functions? Well, you have to change the way you think about databases. If you cast yourself in the role of a programmer designing an application for yourself as a user, you'll do fine. This is a subtle shift in concept, but it works.

I'm still caught up in that transitional process, just coming up to speed with 4th Dimension. I've been trying to craft an application or two or three, then do a little debugging, then change things around. I'm learning. I haven't begun my performance testing, and I haven't even decided if raw speed matters at all with this program. I think this may turn out to be a favorite package, but I'm not quite ready to vote.

So you'll have to wait until next month for the second installment. To be continued.

Fallout

As part of my 4th Dimension evaluation, I needed a good batch of data to form the basis for a test suite. My rules were simple. I wanted a 10,000-record database made up of real-world information, and I couldn't use 4th Dimension to build it. I decided that since I write about applications, I should use application software to pull this sample database together. The project turned out to be tougher than it looked on the surface; I would have been better off learning a new programming language from scratch rather than using applications.

Acquiring the raw material was easy enough; I collected lists of names, lists of companies, lists of titles, and lists of cities from various on-line databases. I used Excel on the Mac to randomly generate lists of telephone numbers and ZIP codes. But whipping the lists into shape and compiling them into a database became a nightmare. The lists had to be cleaned up, capitalization standardized, and the data scrambled. Then everything had to be pulled into one enormous file. Here are some of the winners and losers among the application programs I tried.

No word processor on the Mac is particularly good with columnar material; I had to ship many of the lists over to the Tandon AT clone to process them. MicroPhone 1.1 beat out Red Ryder 9.4 as the telecommunications package on the Mac; Red Ryder tops out at only 9600

continued

Ezra Shapiro is a consulting editor for BYTE. Contact him at P.O. Box 146069, San Francisco, CA 94114. Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

bits per second, which is far too slow when you're cabling machines together and sending huge files.

Once I had my lists on the Tandon, XyWrite III was the most successful tool for getting all the text capitalized normally. MS-DOS Word 3.1 choked on my large files (the major problem was the Undo buffer—I was constantly running out of memory). WordStar 3.3 had no real problems, but it was s-l-o-w. XyWrite was frighteningly quick, and its programming/macro facilities were a tremendous help.

Back on the Macintosh, both Excel (spreadsheet) and Works (spreadsheet and database) failed me. They're snails at importing and exporting text (remember, I'm talking about 150,000 cells of data). FileMaker Plus had the easiest and quickest algorithms for importing columns of data into an existing file; it became my choice for pulling the lists into database format. Borland's Reflex for the Mac came in second, but its automatic indexing turned my giant database into an ugly, bloated monster.

Editors' Lifesaver

I've seen a lot of file-comparison programs. Most of them are line-oriented; that is, they show the difference between two files by printing a changed line in the later file underneath the appropriate line from the first file. This may be fine for looking at program listings, but it's inadequate for text documents. Once a long insertion or deletion changes the length of even one line, many line-oriented comparison programs are out of sync forever.

CompareRite (JURISoft, $129.95) is a file-comparison program optimized for text, and it's a dandy. It comprehends the file formats for most major MS-DOS word processors, and it's phrase- and paragraph-oriented. That means it can resynchronize itself neatly and provide an intelligible record of changes in prose documents. Also, CompareRite displays changes within the body of your text, or following the document as end notes, rather than beneath it.

You feed the program the filenames from your original document and the revised version and indicate the character attributes that you'd like to see both for phrases deleted from the original and phrases added to the revision. CompareRite spits out a new file combining the two with, for example, deletions shown in italic and insertions shown in boldface. These display options are limited only by the ability of your word processor. If you like, you can dump the comparison output to your screen and indicate changes in different colors.

It's all fast and simple. You can change word processors by invoking the program with a command-line parameter; display attributes can be changed from the program's easy menus. Not much more to it.

My only caution is that CompareRite is best for showing the editing of documents relatively late in the process; you wouldn't want to use it to compare versions of a document that has been completely reorganized or rewritten. It's perfect for legal work, where slight changes in wording are of paramount importance.

The program disk comes to you copy-protected, but removing the protection is not particularly odious. Just call JURISoft's toll-free number to register the software, and they'll tell you how to eliminate the protection scheme. You don't have to spend extra money or wait for a disk by return mail.

Nothing at all went wrong when I tested the program. If you need it, buy it.

Electronic-Mail Afterthoughts

In July, I wrote about Lotus Express and Desktop Express, two software packages that automate dealing with MCI Mail. So far, I've received more correspondence about that column than any other I've written. From users, the basic response seems to be that while the interface to Lotus Express is every bit as awful as I reported, I severely undervalued the product's utility. MCI addicts in the MS-DOS world apparently can't live without it. So I'm backing off, a little, from my condemnation of Lotus Express.

The program is a memory hog with a miserable interface, but if you use MCI Mail a lot, you should probably take a deep breath and buy it; those who use it regularly swear by it.

I also got quite a bit of mail, mostly via MCI Mail, from software developers working on electronic-mail products. At last count, the scorecard read: four companies with "universal" electronic-mail packages designed to provide a standard interface for all your electronic communications; two companies offering microcomputer-to-microcomputer products for messaging without the use of commercial systems; one OEM-level product that lets you develop your own interface to MCI Mail; and one mail system built into Ashton-Tate's Framework. Of these vendors, I'd only heard of two, and neither of those are known for telecommunications products. I'll have more to report when I've sorted it all out.

Finally, hats off to Bob Frankston of Lotus and Tom Evslin of Solutions (the firm that developed Desktop Express for Dow Jones). Those two gentlemen broke through corporate protocols and talked to each other; as a result, their products can now talk to each other. PCs and Macs can exchange binary files over MCI Mail with ease.

continued

Items Discussed

CompareRite $129.95
JURISoft Inc.
763 Massachusetts Ave.
Cambridge, MA 02139
(617) 864-6151

Desktop Express $149
Dow Jones Software
P.O. Box 300
Princeton, NJ 08450
(609) 452-2000

FileMaker Plus $295
Forethought Inc.
250 Sobrante Way
Sunnyvale, CA 94086
(408) 737-7070

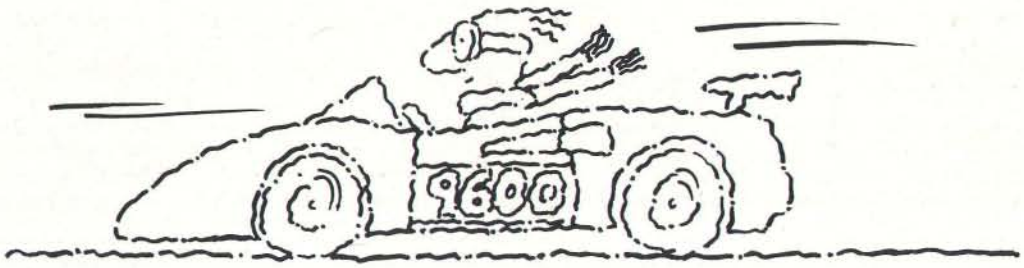
4th Dimension $695
Acius Inc.
20300 Stevens Creek Blvd.
Suite 495
Cupertino, CA 95014
(408) 252-4444

Guide
Macintosh $134.95
MS-DOS.....$199.95
OWL International Inc.
14218 Northeast 21st St.
Bellevue, WA 98007
(206) 747-3203

Lotus Express $100
Lotus Development Corp.
55 Cambridge Parkway
Cambridge, MA 02412
(617) 577-8500

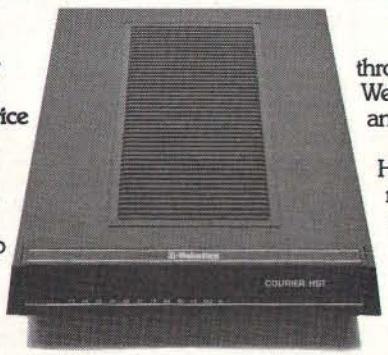
MicroPhone.....$149
Software Ventures Corp.
2907 Claremont Ave.
Suite 220
Berkeley, CA 94705
(415) 644-3232

XyWrite III.....$395
XyQuest Inc.
3 Loomis St.
Bedford, MA 01730
(617) 275-4439



Now go 17,400 bps in under $1000.

The new Courier HST modem.



PC Magazine calls USRobotics' Courier HST,™ "the top price-performance ratio at 9,600 bps." Now we've made it almost twice as fast without raising the price.

Our new full-duplex High Speed Technology dial-up modem with MNP™ Level 5 data compression is totally AT command set compatible, delivering data at up to 17,400 bps. And automatic fall-back/fall-forward always assures the fastest speed possible. Courier HST reduces phone line costs every time you use it.

When you buy an HST modem, you get USRobotics' more than 10 years of modem experience gained through sales of over half-a-million modems. We're an organization that will support you and grow with your needs.

PC Week says, "USRobotics' Courier HST produced the most impressive test results based on the modem's suitability to both file transfer and interactive applications."

Other modems talk about speed. Courier HST delivers. Get your hands on one... *fast!*

Free Warranty Extension! Buy an HST before December 31, 1987 and receive a 3-year warranty extension FREE. A $50 value.*

Call 1-800-DIAL-USR Ext. 37

In Illinois (312) 982-5001

US Robotics™

The Intelligent Choice in Data Communications.

8100 McCormick Blvd., Skokie, Illinois 60076.

MNP is the Microcom, Inc. trademark for Microcom Networking Protocol, a public domain error-control protocol.

*Total warranty including extension: 5 years.

Circle 284 on Reader Service Card (Dealers: 285)

There's only one "gotcha" in this file-transfer system; you can't use MS-DOS computers to receive programs for Macs. Lotus Express receives binary material from Desktop Express as three distinct blocks. The first block is the Macintosh file-header information, which Lotus Express interprets as an ASCII MCI message. Next comes the data fork, which Lotus Express accepts as an attached binary file. The third block is the Macintosh resource fork; Lotus Express can't understand it and ignores it.

Anyone transferring binary data files, like spreadsheets, will have no trouble; Mac resources are not often used in data files. However, this does rule out using a PC as a mail server if you intend to receive Mac programs and distribute them later. I don't suspect many people are dedicating machines to electronic mail yet, so I see this as a minor flaw. But if you're planning to get real fancy with MCI Mail, be warned—PCs will choke on Mac programs unless you go through that archaic BinHex ritual. If none of this makes any sense to you, that means you're safe.

Mea Culpa

After the first column in which I mentioned Guide, the hypertext system for both the Mac (and now the PC), I received a rather embarrassing note from Professor Peter J. Brown at the University of Kent at Canterbury. He writes:

"As the person who originally developed the basic ideas behind Guide, I was pleased to read your generally kind review.... My pleasure was dashed, however, when I came to the end and found credit given to the University of Edinburgh rather than to my University, the University of Kent. To put it in your terms, it was a bit like an American athlete winning an Olympic medal, and then the band playing the Russian national anthem by mistake.

"I would be glad, therefore, if you could find the space to correct the attribution. I might add that I am more than happy for the major credit to go to OWL [OWL International Inc.], who have taken my basic research ideas and successively enhanced them and turned them into a successful and well-marketed product.

Yours sincerely,
P. J. Brown
Professor of Computer Science"

Whoops. In my feeble defense, I note that OWL's press package mentions a research arrangement with the University of Edinburgh. However, elsewhere in the same paragraph, OWL correctly locates Professor Brown at Kent. Apologies to all concerned. ■

BUY THE NUMBERS.

There's only one way to make sure that you're buying a genuinely high-performance system and that's to evaluate the competition by the real numbers.

And when you compare Tandon's numbers against our major competition there's no doubt who's really selling the systems of the future.

		TARGA 20	PS/2 MODEL 30	TARGA 40 PLUS	PS/2 MODEL 50
1	**PROCESSOR:**	**80286 6/8 Mhz dual speed**	8086 8 Mhz	**80286 8/10 Mhz dual speed**	80286 10 Mhz
2	**MEMORY:**				
	Standard	**1 MB**	640 KB	**1 MB**	1 MB
	Memory Management	**Yes**	No	**Yes**	No
3	**DISK STORAGE:**				
	Capacity	**20 MB**	20 MB	**40 MB**	20 MB
	Effective access time	**85 ms**	85 ms	**35 ms**	85 ms
4	**COMPATIBILITY:**				
	5¼" floppy	**Yes**	No	**Yes**	No
	Runs OS/2	**Yes**	No	**Yes**	Yes
5	**PRICE:**	**$1,999**	$2,295	**$2,995**	$3,595

Take the excitingly priced Targa 20. Thanks to its powerful 80286 processor it dramatically outperforms the PS/2 model 30. And it supports Microsoft's OS/2, the operating system standard of the future.

Or put the Targa 40 up against their PS/2 model 50. Double the storage capacity, innovative disk cache technology, and a Tandon low price.

So whether you need a powerful system to help you manage your business, or else a high-performance file server at the heart of your network, the Tandon Targa is the ideal fit.

For more details on the powerful Tandon Targa family call: National 1-800-556-1234 ext. 171, California 1-800-441-2345 ext. 171.

Tandon

Please send me your Tandon Fact Pac, a comprehensive set of literature and product reviews:

Name

Company

Address

City/State/Zip

Telephone

Tandon Computer Corporation
405 Science Drive
Moorpark, CA 93021
(805) 378-6104

BYTE 10/5

PS/2 and OS/2 are registered trademarks of IBM Corporation. Microsoft Windows is a registered trademark of Microsoft Corporation. Prices displayed do not include monitor.

The new generation of software development tools are here.

Now . . .

. . . It's Your Move

Arity . . .

The only fully-integrated family of software development tools designed for today's programming needs.

You're looking for a language which can handle today's programming tasks: expert systems, natural language, relational databases, intelligent human interfaces. Your best move is Arity/Prolog. Arity/Prolog is the foundation for a variety of programming tools designed to meet your programming needs.

Prolog

Arity/Prolog is a true superset of the Edinburgh Prolog standard. It includes features such as one gigabyte of virtual memory, complete string support, database partitioning, definite clause grammar support, and full MS-DOS access. And Arity/Prolog has highly-developed interfaces to other programming languages, such as C, assembly, and Pascal. So you don't have to abandon your existing development efforts to take advantage of the power and flexibility of Arity/Prolog. Arity/Prolog is the overwhelming choice of users and reviewers alike as the premier Prolog implementation for IBM PCs and compatibles.

Expert Systems

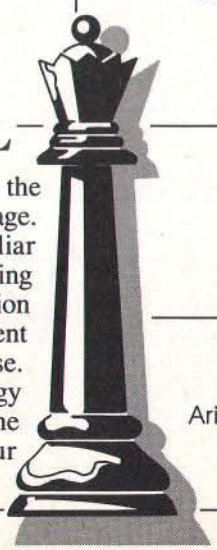
Arity/Expert is a programming tool which bridges the gap between a human's view of a problem and a computer's view of the problem. Arity/Expert is a frame-based system which features backward chaining, automatic explanation generation, positive and negative confidence factors, and complete system debugging facilities. And Arity/Expert is designed with a unique open-ended architecture that allows you to customize your expert system to match your individual needs.

Check us out!

Call today for more information on the Arity family of software development tools.

1-800-PC-Arity
(Mass: 617-371-1243)

SQL



Structured Query Language (SQL) is fast becoming the industry standard relational database interface language. The Arity/SQL package lets you easily add this familiar database interface to your Arity/Prolog applications. Using Arity/SQL queries, you can easily display specific information from a database table, combine data from many different tables, and perform comparisons among data in the database. If you're planning to incorporate relational database technology into any of your applications, you'll want to use the combination of Arity/Prolog and Arity/SQL to speed your development efforts.

Circle 19 on Reader Service Card

A R I T Y

Arity Corporation 30 Domino Drive
Concord, Massachusetts
01742

The Best of BIX is a quick glimpse at just a few of the thousands of messages exchanged every month by BIX users. If you'd like more information on BIX, see the advertisement on page 267.

MACINTOSH

The Macintosh section this month is taken up entirely with a extended discussion of numeric performance of the Macintosh II and that ever-controversial subject among BIXen: benchmarks.

THE GREAT MAC II COPROCESSOR AND BENCHMARK DEBATE

macintosh/mac.ii #292, from tomwallace (Tom Wallace), Tue Jun 23 09:34:47 1987.

I have just run a few benchmarks on the Mac II and the Compaq Deskpro 386 with a 387:

```
Savage (transcendental functions):
   Compaq 386/387          5.5 sec (10,000 iterations)
   Mac II                  101.0 sec (10,000 iterations)

Sieve (integer arithmetic):
   Compaq 386/387          188 sec (1000 iterations)
   Mac II                  117 sec (1000 iterations)
```

Both of these were run using the appropriate version of Turbo Pascal. The Mac II version included the "uses SANE" specification but defined its own Tan function (in the Savage benchmark) to stay as close as possible to the Compaq version.

My question is, why is the Mac II so slow at floating-point? I'm sure the 68881 is capable of much better performance. Is there really a 2000 percent overhead in accessing the 68881 through the SANE, compared to generating in-line floating-point instructions?

It would be interesting to see some benchmarks run using something like Fortran/020, which I don't have. The two systems should be fairly similar in floating-point speed if the software doesn't get in the way.

macintosh/mac.ii #309, from bwebster (Bruce Webster), Thu Jun 25 21:49:17 1987. A comment to message 292.

I don't know what's wrong with Turbo Pascal, but the problem isn't with the Mac II. I just ran the Savage benchmark in Mac C (the 68020/68881 version); it did 10,000 (not 1000) iterations in 2.2 seconds. A version compiled on the Mac Plus in Lightspeed C (version 2.01) did 2500 iterations in 23.2 seconds (which would factor down to 9.3 seconds for 1000 iterations). The Mac C compiler makes direct 68881 calls, while Lightspeed goes through SANE.

macintosh/mac.ii #293, from lloeb (Larry Loeb, conference comoderator), Tue Jun 23 09:44:24 1987. A comment to message 292.

One of the background things going on for the SE accelerator boards review is that I am recoding the benchmarks with the Consulair C/020 compiler to investigate *just* that point. I'll let you know what difference it makes when *I* find out.

macintosh/mac.ii #294, from tomwallace, Tue Jun 23 17:00:23 1987. A comment to message 293.

Good deal. If you would post the benchmarks you're using, I can run them on the 386/387 for comparison. It's a shame that the SANE doesn't provide better performance with the 68881. It leaves existing software with no efficient way of using the floating-point hardware, and makes it difficult for developers to write software that runs on the whole Mac family and uses each to its fullest.

For a depressing illustration of how small the speed increase is, the same Savage benchmark referred to in message #292 ran on an SE in 880 seconds. Of the 9x speed increase, 2x can be accounted for by the difference in clock speeds, and another 1.5 to 2x by the wider bus and faster instruction execution. This leaves a speed increase of 2x resulting from the use of floating-point hardware rather than software emulation. I don't know a lot about SANE, but it seems like a revision could boost this a lot. Many of the operations required by the IEEE standard are done in hardware on the '881, anyway.

macintosh/mac.ii #295, from lloeb, Tue Jun 23 17:35:48 1987. A comment to message 294.

The source to the benchmarks may or may not help. What compiler it's compiled under may.

macintosh/mac.ii #310, from bwebster, Thu Jun 25 21:50:22 1987. A comment to message 294.

I'd like to see your source to Savage. It's hard to believe that the Turbo Pascal performance would be so poor. On the other hand, I have a patched beta of TP working on the Mac II, so maybe I should go test it myself.

macintosh/mac.ii #296, from lmeier (Lyle Meier), Tue Jun 23 21:28:21 1987. A comment to message 292.

I believe the '387 has built-in transcendental functions on the chip (i.e., a Sin or Cos or Tan instruction). Likely the 68881 does not; I don't recall. This could make a difference in the speed if the Mac was having to compute the Tan on the 68881 using software while the '387 was able to do it on the chip.

macintosh/mac.ii #301, from reviews6 (Joel West), Wed Jun 24 00:08:21 1987. A comment to message 296.

The 68881 has: Sin, Cos, and Tan; also Arc, Hyperbolic, and Arc Hyperbolic log10, log2, ln, and Exponential using 10, 2, and e square root.

Of course, not all compilers generate instructions for this. For example, Apple's MPW Pascal and C compilers (2.0 beta) use separate options for 68881 arithmetic and trancendentals, since the latter are slightly less accurate than SANE.

macintosh/mac.ii #303, from tom__thompson (Tom Thompson, BYTE), Wed Jun 24 08:46:24 1987. A comment to message 301.

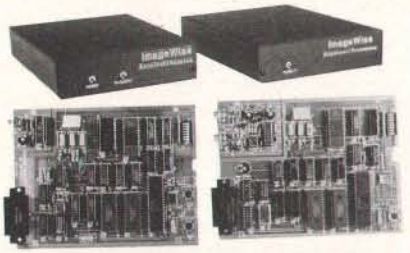
The problem seems to be with using SANE calls with the 68881. We've talked to two vendors (one with an instrumentation package, one with a CAD/CAM program) whose products used

continued

MICROMINT'S Gold Standard in Single Board Computers & Controllers

Announcing

DT01/DR01
Serial Digital Imaging System



MICROMINT INTRODUCES A STAND-ALONE SERIAL DIGITAL IMAGING SYSTEM. The MICROMINT **ImageWise™ Serial Digital Imaging System** is the most cost effective and versatile high performance grayscale video digitizing system on the market today. The ImageWise system has been designed to function as a standalone digitizer or as an integral component of a complete tele-imaging system. **ImageWise™'s** serially bit mapped digitized pictures give it almost universal compatibility with any computer capable of attaching to a modem or terminal. It is ideally suited for CAD/CAM, Desktop Publishing, automatic inspection, and security applications. Critical-System functions such as image resolution and picture update can be controlled and commanded remotely. Images are transmitted and received serially, either compressed or uncompressed, and can be displayed, transmitted, stored, edited, or processed for use in a variety of industry standard application software.

IMAGEWISE SYSTEM SPECIFICATIONS

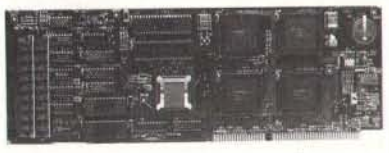
- NOT bus dependent – can function standalone
- True frame grabber – uses a high speed flash A/D converter and 64K bytes of static RAM to capture an image in 1/60th second.
- Accepts any B/W or color NTSC video signal.
- Stores pictures as 244 lines of 256 pixels, 64 levels grayscale.
- Resolution of transmitted image is software selectable, all images are represented in 64 levels of gray scale.
  - Selectable Resolutions:
  - High: 256x244x6
  - Med: 128x122x6
  - Low: 64x61x6
- Video Input: 1 vpt peak-to-peak, B&W or color 75 ohm termination
- Video Output: 75 Ohm, 1.5 V peak-to-peak NTSC composite video
- Serial Input/Output: RS-232 – 8 bit, one stop bit, no parity 300 bps – 57.6Kbps selectable data rate – Xon / Xoff Handshaking Switch selectable data compression (on/off)
- Modem compatible: Easily functions as a video telephone to send video images anywhere.
- Video processing, disk upload/download, and display utilities provided for PC-DOS and MS-DOS machines

Optional PC Utilities Disk converts ImageWise™ files for use with popular Desktop and Paint Programs.

DT01	ImageWise Digitizer / Transmitter	$349.00
DR01	ImageWise Receiver / Display	$349.00

Announcing

OEM-286 — $775.00
complete PC/AT-CPU



Low Power!

Expansion Card Form Factor!

100% AT Compatible!

MICROMINT's **OEM-286** is a complete PC/AT-CPU and more. The **OEM-286** is the first low power, 100% AT compatible which has been specifically designed for OEM use within the industrial and business sectors. The **OEM-286** features the Zymos CMOS POACH set and 100% compatible Award BIOS. The development of the POACH chip set has allowed the 199 IC's on a standard AT to be reduced to 20 IC's and two SIMMS. What this means for you is:

1) The overall size of a standard AT/CPU has been condensed into the expansion card form factor. (15¼" x 5⅞")
2) Power requirements are less then 1 A @ 5 volts.
3) **OEM-286** plugs into a passive backplane for easy connection to other expansion peripherals.

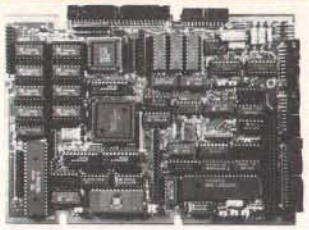
The **OEM-286** is available in both 8 and 10 Mhz versions and comes with the Award BIOS

OEM-286 FEATURES

- 100% AT compatible
- 80286 Microprocessor, 8 or 10 Mhz
- 80287 Co-Processor optional
- 64 Kbytes of ROM, can accommodate 128 Kbytes
- 512 Kbytes of RAM
- Keyboard Controller
- Expansion card size factor
- Standard interface to the System Expansion Bus
- Battery backed real time clock
- Award BIOS included.

OEM-286/8	8 MHz AT/CPU	$775.00
OEM-286/10	10 MHz AT/CPU	$825.00
OEM-286/BP	8 SLOT PASSIVE BACKPLANE	$115.00

SB180FX — $409.00
Single Board Computer



SB180FX TECHNICAL SPECIFICATIONS

PROCESSOR
- Hitachi HD64180, an 8-bit CPU in a 68 pin PLCC package
- Superset of Z-80 instruction set, including hardware multiply
- Integrated Memory Management Unit with 512K bytes address space
- Dynamic RAM refresh
- Wait state generator
- Clocked serial I/O port
- 2 channel Direct Memory Access Controller
- 2 channel Asynchronous Serial Communication Interface
- 2 channel 16-bit Programmable Reload Timer
- 12 interrupts
- Dual bus interface to 68xx and 80xx support chips
- 6.144MHz, 9.216MHz, and 12.288 MHz system operation

MEMORY
- 512K bytes dynamic RAM on board
- Memory externally expandable to 4 Mbyte RAM
- Either an 8K 8764, 16K 27128, or 32K 27256 EPROM usable
- Full function 8K ROM resident monitor

INPUT/OUTPUT
- Console RS-232 serial port with auto-baud rate select to 38,400 baud
- Peripheral RS-232 serial port, full handshaking, 150-38,400 baud
- Line printer parallel I/O port
- 24 bits bi-directional parallel I/O
- 19-bit address decoding. I/O port decoding, and dual bus interface brought out to expansion bus connector
- Can be directly attached to GT180 640 x 480 color graphics adapter
- Fully implemented SCSI hard disk and communications bus interface.

FLOPPY/RAID DISK INTERFACE
- Uses Standard Microsystems 9266 disk controller
- Compatible with NEC 765A controller
- On-chip digital data separator
- Can control 3½", 5¼", and 8" floppy disk drives – up to 4 in any combination
- Handles both FM encoded (single density) and MFM encoded (double density) data.
- NCR 53C80 SCSI bus controller for hard disk or network communication.

SOFTWARE COMPATIBILITY
- CP/M, ZRDOS, ZCPR3 Compatible

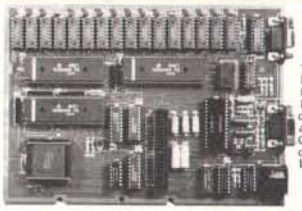
SB180FX-1	SB180FX - 6.144 MHz computer board populated w/ 256K bytes RAM, 8K byte ROM monitor, without SCSI chip. Add $50.00 for 9 MHz.	$409.00
SB180FX-1-30	SB180FX-1 computer board as described above with Z-System software including ZRDOS, ZCPR3, editor, utilities, ZAS assembler, and ZDM debugger. BIOS and ROM monitor sources, and BIOS for SCSI hard disk. Supplied on five 5¼" SB180 format DSDD disks.	$499.00

SB180 — $299.00
Single Board Computer

SB180-1	SB180 - 6.144 MHz single board computer w/256K bytes RAM and ROM monitor. Add $50.00 for 9 MHz	$299.00
SB180-1-20	Same as above w/ZCPR3, ZRDOS, BIOS and ROM sources	$399.00
COMM180-S	SCSI Hard Disk Interface	$150.00

SB180-1 OEM 100 QUANTITY PRICE $195.00

GT180 — $395.00
Graphics Display System



The **GT180** has both TTL RGB (red-green-blue intensity) and analog RGB outputs. It totally compatible with virtually all standard and multiscan CRT monitors, and has a connector for an IBM PC keyboard.

The **GT180** offers these features:
- Advanced graphics controller provides intelligent link between computer and user
- Only 5.75" x 8", piggy-backs on either an SB180 or SB180FX computer
- High resolution at a low cost: 640 x 480 with 16 of 4096 colors
- Hardware drawing commands: LINE, RECTANGLE, POLYLINE, POLYGON, CIRCLE, ELLIPSE, ARC, FILLED RECTANGLE, PAINT, PATTERN, WINDOW, and COPY to name but a few
- Automatic translation of logical X-Y coordinates to physical frame buffer addresses
- Fast drawing speed of 2 million pixels per second
- Provides fully programmable horizontal split screens and window screen
- Fully supported by **GT180** Graphix Toolbox written in Modula-2

GT180-1	Graphic Display Expansion Board (TTL, RGB only)	$395.00
GT180-2	Graphic Display Expansion Board (TTL RGB and Analog RGB)	$449.00

SB180
Software and Accessories

SB180-U	Uniform Disk Format Conversion Software	$ 69.95
SB180-ZMSG/TKBBS	Z-MSG Bulletin Board Software	$100.00
SB180-MOD2	Turbo Modula 2	$ 69.00
SB180-MOD2G	Turbo Modula 2 w/Graphix Toolbox	$ 89.00
SB180-CASE	Four half height 5¼" drive enclosure w/power supply, mounting brackets and hardware for the SB180 or SB180FX	$197.00
SB180-CABLE	Set of 4 cables including power, term. disk and print	$ 79.00

BCC22 — $249.00
Term-Mite Smart Terminal

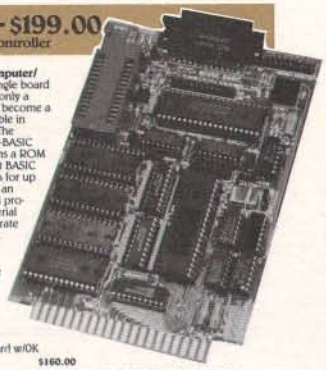
Why pay $500 or more for a smart terminal? The **TERM-MITE ST** offers you all of the following on a single board for less than ⅛ the price.

- Dimensions: 4" x 6½"
- 128 displayable characters
- 24 lines x 80 characters
- Separate transmit & receiver baud rates(110-19,200bps)
- CRT refresh at 50 - 60 Hz
- Supports scanned and encoded keyboards
- 11 Graphic characters
- 25th line reverse video status display
- 21 escape functions
- 14 control functions
- Directly drives composite video or separated sync monitor
- All functions are firmware controlled. Source code available

EDITING FEATURES: typeover,clear to screen to space or null, erase to end of page, erase to end of line, absolute cursor addressing.
VIDEO ATTRIBUTES: reverse video, half intensity, double height, double width, underlined, blinking and blank characters.
BUS CONFIGURATION: MICROMINT BCC compatible or no bus connection neccessary for stand-alone operation with parallel keyboard.

BCC22	TERM-MITE Smart Terminal Board	$249.00
BCC22K	PARALLEL Encoded ASCII KEYBOARD plugs directly into TERM-MITE	$ 79.00

BCC52 — $199.00
BASIC 52 Computer/Controller



The MICROMINT **BCC52 Computer/Controller** is a stand-alone single board microcomputer which needs only a power supply and terminal to become a complete system programmable in BASIC or machine language. The **BCC52** uses the Intel 8052AH-BASIC microprocessor which contains a ROM resident 8K byte floating point BASIC interpreter. It contains sockets for up to 48K bytes of RAM/EPROM, an "intelligent" 2764/128 EPROM programmer, 3 parallel ports, a serial terminal port with auto baud rate selection, a serial printer port.

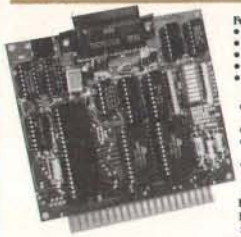
BCC52*
Basic-52 Computer/Controller
$199.00

OEM 100 QUANTITY PRICE
$149.00

BCC53
Multi Function Expansion Board w/0K adds 6 ports and 60K bytes **$160.00**

***NOW AVAILABLE IN INDUSTRIAL TEMPERATURE RANGE – CALL FOR INFORMATION**

BCC11 — $139.00
Basic Controller



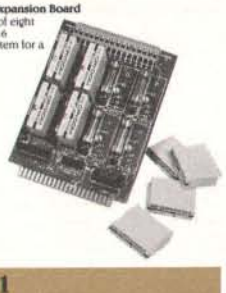
Features:
- Uses Z8 single chip microcomputer
- On board tiny basic interpreter
- 2 on board parallel ports & serial port
- 6 interrupts (4 external)
- Just connect a CRT and write control programs in Basic
- 6K Bytes of RAM or EPROM memory on board
- Baud rates 110-9600 bps
- Data and address bus available for 56K memory and I/O expansion.
- Consumes only 1.5 watts at +5, +12 & – 12V.

BCC11*
BASIC System Controller
$139.00

***NOW AVAILABLE IN INDUSTRIAL TEMPERATURE RANGE – CALL FOR INFORMATION**

BCC40 — $159.00
Power I/O Expansion Board

The MICROMINT **BCC40 POWER I/O Expansion Board** provides on/off control and monitoring of eight 115-230 VAC or 5-48VDC devices. Up to 16 POWER I/O boards may be used in a system for a total of 64 inputs and 64 outputs.



BCC40
POWER I/O Expansion Board (with no power modules) **$159.00**

with 8 Output Modules **$249.99**

with 8 Input Modules **$229.99**

BCC52 & BCC11
Software and Accessories

BCC52-ROM A	ROM A Utilities-BASIC extensions	$ 49.95
BCC52-ROM A/B	ROM A and B Utilities	$100.00
BCC52/41	BASIC extensions and Assembler ROM C Utilities-Real Time Clock and Power I/O firmware	$ 34.00
BCC52-0K-CLK	SMARTIME BCC52 Clock and ROM C	$ 69.00
BCC52-8K-CLK	SMARTIME BCC52 Clock w/8K RAM and ROM C	$ 79.00
BCC53	Multi Function Exp. Board w/0K – adds 6 ports and 60K Byte	$160.00
BCC08	Serial I/O Expansion Board	$149.00
BCC09	RS-232 to 20ma Converter	$ 55.00
BCC13	8 Bit, 8 channel A/D Board	$129.00
BCC30	12 Bit, 16 channel A/D Board	$197.00
BCC25-4	4x20 LCD Display	$159.00
BCC25-8	8x40 LCD Display	$229.00
BCC22K	Parallel Enclosed ASCII keyboard	$ 79.00

MOTHER BOARDS – CARD GAGES – POWER SUPPLIES

MB02	5 Slot mini-mother board (not compatible with CC01, CC02)	$ 69.00
MB08	8 Slot full mother board (compatible with CC01/CC02	$ 85.00
MB44	44 pin gold card edge connector	$ 6.00
CC01	10 inch Card Cage for one MB08	$ 59.00
CC02	19 inch Card Cage for two MB08s	$ 79.00
UPS11	Universal Power Supply – used for single board applications .9A @ 5V, .3A @ + 12V and .1A @ – 5V	$ 19.00
UPS05	Card Cage Power Supply – designed for 2 or 5 board system 1A @ 5V, .3A @ + 12V, .1A @ – 12V.	$ 79.00
UPS10	Heavy Duty Switching Power Supply – used for an entire BCC system 5.5A @ 5V, .7A @ + 12V, .3A @ – 12V	$ 69.00
UPS21	21 Volt Programming Power Supply – used for EPROM programming on the BCC52 21V +/– 2% @ 300ma	$ 49.00

To order call

1-800-635-3355

for technical information **1-(203)-871-6170**

TELEX: 643331

Micromint, Inc.
4 Park Street
Vernon, CT 06066

trigonometric calculations extensively, and both had written code that accessed the 68881 directly for at least a 100% boost in performance. No, this isn't kosher from a device-independent-code standpoint, but the cost of device independence is that math performance is crippled. Apple is supposedly working on programmer tools to access the 68881 directly.

---

macintosh/mac.ii #304, from lloeb, Wed Jun 24 09:07:44 1987. A comment to message 303.

First pass with the Float benchmark shows a 10x increase in performance; not just 100%.

---

macintosh/mac.ii #305, from reviews6, Thu Jun 25 10:34:23 1987. A comment to message 303.

The MPW 2.0b1 Pascal compiler (now available from ADPA) has a 68020 toggle and two 68881 toggles. The first, -mc68881, does the arithmetic using the '881; the second, -d ELEMS881, does the trancendentals using the '881.

The MPW C 2.0b2 C compiler has similar options; I don't know if it is currently being sold by ADPA, but clearly, the final 2.0 will have it.

---

macintosh/mac.ii #312, from bwebster, Thu Jun 25 22:19:45 1987. A comment to message 309.

At this point, I don't know what's wrong with your benchmark. I just keyed up a quick version of Savage in Turbo Pascal, compiled it, and ran it with 1000 iterations; it ran in just about 9 seconds flat, or about the same speed (a little faster, actually) than Lightspeed C. Here's the complete source code:

```
************** SAVAGE BENCHMARK IN TURBO PASCAL **************
program Savage;
{$R-}
{$I-}
{$U-}
uses
PasInOut,PasConsole,SANE,MemTypes,QuickDraw,OSIntf,ToolIntf;

const
  ILOOP          = 1000; { number of iterations }
var
  I                      : Integer;
  A                      : Extended; { 80-bit precision }
  Start,Finish,Delta     : LongInt;  { for timing }
begin
  Write('Press return to start benchmark: ');
  Readln;
  Start := TickCount;
  A := 1.0;
  for I := 1 to ILOOP do
    A := Tan(ArcTan(Exp(Ln(Sqrt(A*A))))) + 1.0;
  Finish := TickCount;
  Delta := Finish - Start;
  Writeln('A = ',A:20:14);
  Writeln('time = ',Delta,' ticks');
  Readln
end. { of program Savage }
**********************************************************
```

I compiled this on the Mac II using TP 1.00e, a version patched to let you get back to Turbo Pascal after running a program (Borland says it's a ROM bug that they have to work around). It ran in 538 ticks; then I ran it on the Mac II and got the same results. Incidentally, that same code file took 4450 ticks (74.2 seconds) on the Mac Plus.

continued

macintosh/mac.ii #316, from tomwallace, Fri Jun 26 15:11:27 1987. A comment to message 312.

Yes, that's almost identical to my benchmark. I got 101 seconds (hand-timed) for 10,000 iterations, so there isn't any real disagreement about how long it took. My point was that SANE wasn't doing a good job of getting at the '881, and that existing PC software did a better job of using the 80387 than existing Mac software (and compilers) do using the 68881. One of the things that a well-designed SANE could do is allow portability across the whole Mac family without the necessity of including run-time checks for the presence of a coprocessor, which is what PC software generally does.

By the way, where did you get the TP patch? I got tired of rebooting while I was running those benchmarks.

---

macintosh/mac.ii #319, from bwebster, Fri Jun 26 18:49:21 1987. A comment to message 316.

Aha! I think your message said *1000* iterations, not *10,000* (which is why I was so startled by your timings). Makes me feel a bit better. As for SANE's performance with the 68881...yeah, I think it's pretty crummy, too. Two orders of magnitude are inexcusable.

---

macintosh/mac.ii #322, from dgoldsmith (David Goldsmith), Fri Jun 26 22:55:08 1987. A comment to message 319.

For compatibility, it was necessary for Mac II SANE not to use the built-in transcendentals on the '881. This is because these functions are less accurate than SANE's, and programs might have stopped working (or at least given different answers). Of course, SANE uses the '881 arithmetic for its own transcendental implementation. This is where you are seeing the big hit. Compiler options in MPW 2.0 allow you to use the '881 transcendentals directly.

---

macintosh/mac.ii #315, from tomwallace, Fri Jun 26 14:59:29 1987. A comment to message 309.

That's the point I was making.

    10,000 iterations in 2.2 seconds using 68881 directly
    10,000 iterations in 93 seconds using SANE

I know that the 68881, when directly called, will yield performance approximately equivalent to the 80387 (+/- a factor of 2). What I was concerned about was the gross inefficiency of the SANE in using the coprocessor. WHY will we have to face that huge overhead when using or writing any software that isn't specifically designed for the Mac II?

---

macintosh/mac.ii #318, from kswartz (Karl Swartz), Fri Jun 26 18:16:32 1987. A comment to message 292.

I did some benchmarks on the various floating-point options on some Sun 3/160s, which have a 16.67-MHz 68020 and a 16.67-MHz (?) 68881. These clocks are close to the Mac II, so the data should be relevant.

The compiler options I tested were -f68881 (in-line code for the '881) and -fswitch (links to a run-time module, which uses what's available, the '881 in this case). Looking only at the floating-point sections of my code, I came up with a 20x to 30x performance improvement by using the in-line code.

In this case, the -fswitch library should be little more than a function that does the in-line stuff, so I would expect the Mac II figures to be *at least* this large.

---

macintosh/mac.ii #386, from mboich (Mike Boich), Mon Jul 6 14:20:05 1987. A comment to message 292.

SANE definitely introduces plenty of overhead. In addition, SANE is pickier about calculating elementary functions than is the '881, so rather than one '881 operation, most trig functions generate a series of calls to PACK4. So, yes, your worst fears are true. To see the '881 really fly, get MPW, and set all the right compiler directives. (I don't have them handy, but you want to tell it that you have an '881, and that you aren't super paranoid about precision.)

macintosh/mac.ii #317, from tomwallace, Fri Jun 26 15:42:41 1987.

After reflecting a little about the discussion above, I'd like to expand on my comments. I believe that a standard numeric environment is a wonderful idea, but that the current SANE isn't doing its job well.

Isn't it nice programming a Mac for graphics and not having to worry about the hardware the program will run on? The SANE could offer the same flexibility and convenience for numeric calculation, if it took the responsibility for interfacing with the hardware (which it does) and offered reasonable efficiency (which it apparently does not, at least for floating-point calculations).

In the PC world, if you want a program to use the 80x87, you have two choices: Compile the program with 87-only code, preventing it from running at all on non-87 machines; or test at run time for a coprocessor, and include both coprocessor calls and emulation routines in the executable code, increasing its size and reducing its speed.

I *thought* that one of the purposes of the SANE was to prevent this sort of silliness. Was that a bad assumption?

macintosh/mac.ii #320, from bwebster, Fri Jun 26 18:52:05 1987. A comment to message 317. Comments.

The assumption was good; the implementation was bad. BTW, I got the patched version of TP direct from Borland.

macintosh/mac.ii #323, from dgoldsmith, Fri Jun 26 23:03:27 1987. A comment to message 320.

The implementation of SANE is about as good as you can expect a software implementation of 80-bit floating point, which calculates transcendentals accurate to the last bit of the mantissa-to-be. It also has to go through the trap dispatcher. Software floating-point, especially if it conforms to the IEEE standard, is just not fast. I know there are faster software floating-point packages for the Mac (Excel has one), but following the IEEE rules and delivering accurate results is much harder. SANE is useful for dealing with ill-conditioned numerical problems, which other floating-point packages just throw up their hands at. Try doing some real numerical work with a language that supports SANE vs. one that doesn't, and you can see the difference true IEEE arithmetic (not just IEEE-"compatible" formats for floating-point numbers) can make.

continued

IBM PC and PS/2

The first thread of this month's IBM PC and PS/2 section is a perfect example of how BIXen enthusiasm and teamwork get together to solve a difficult problem. That's followed by a short thread on setting up AT RAM above 640K bytes. We finish up with a peek at the PS/2 Model 60 and answer the elusive 64-head hard disk question for the PS/2 Model 80.

THE GREAT HARDWARE-INTERRUPT QUEST

ibm.pc/hardware #2728, from hamby (Larry Hamby), Fri Apr 24 23:02:27 1987.

Does anyone know what the address OC at F000:E837 refers to?

I'm receiving an intermittent hardware-interrupt error message at that address, and it may relate to a newly acquired incompatibility between my computer and my PCturbo 286e board. I believe Peter Norton's "Inside the IBM PC" has a table of addresses, in case anyone has that book.

ibm.pc/hardware #2730, from dmick (Dan Mick), Fri Apr 24 23:42:39 1987. A comment to message 2728.

Interrupt OCh is the IRQ4 (for COM2:) interrupt. It's at F000:E*9*37, I think. It is on my Zenith, and those addresses are the same as I recall. Could you be one digit off?

ibm.pc/hardware #2731, from hamby, Sat Apr 25 07:57:06 1987. A comment to message 2730.

I think I got the digits correct. I'm sure I'll get this interrupt message again soon enough to double-check. By the way, another person has suggested that an intermittent HW-interrupt message such as this could be indicative of a degenerating memory chip. What do you think?

ibm.pc/hardware #2732, from dmick, Sat Apr 25 08:06:44 1987. A comment to message 2731.

It just sounded too coincidental that it'd be the OC, what with the "hardware interrupt" (parity and IRQ4 are both HW) and the C and the address that's *almost* the OC address....

I don't know the system well enough. It seems odd that it'd give a message about an intermittent interrupt on anything but memory or an unallocated interrupt, though. Odd. Interrupts do occur due to parity checks. However, they are nonmaskable interrupts (NMIs) and occur on INT 2.

ibm.pc/hardware #2733, from hamby, Sat Apr 25 11:10:23 1987. A comment to message 2732.

How does this sound for a diagnosis: I pulled a jumper at location J12 (on my system), which includes IRQ2, IRQ4, IRQ5, and IRQ7. This jumper is supposed to control the clock/calendar. I had pulled this jumper to accommodate the turbo board. Now that the board is out of my system, would this be causing the message? By the way, I'm not familiar with NMIs. Care to enlighten me?

ibm.pc/hardware #2734, from dmick, Sat Apr 25 11:54:53 1987. A comment to message 2733.

You pulled one jumper that somehow affected all the IRQs? I'm confused. NMI is just the nonmaskable (read "can't stop this one") interrupt. (Of course, on the IBM, there's a different one out that really *does* mask it, but as far as the normal Clear Interrupt flag instruction and the Interrupt Controller chip are concerned, this one can't be stopped.) Usually, the parity interrupt uses NMI. Some resident debuggers take it over. There are programs around to simply ignore NMI, too, since sometimes memory can be a bit flaky, and, rather than hang the system, some would prefer to take a chance. Nine times out of nine and a half, the "parity error" is a slightly hot chip or a loose card or chip in the socket, and very intermittent. Anyhow, though I can't (now) remember whether you said PC clone or AT clone, which makes a difference (more IRQs around), on PC clones, IRQ4 is the serial port #2 interrupt (8 - IRQ0 - timer, 9 - IRQ1 - keyboard, etc.), and, if you had some sort of COM2 board that was glitching IRQ4, or if the new turbo board was using IRQ4 instead of 2 like most are safer doing, it might be that the system is saying "what's this serial interrupt when you haven't installed a handler?"

ibm.pc/hardware #2739, from hamby, Sat Apr 25 22:49:44 1987. A comment to message 2734.

One last treatise on my HW error message. This whole situation came about as follows: I was was using my Leading Edge Model D (with MS bus mouse and Orchid PCturbo 286e) and was on-line with some service or other when:

1. I got the HW-interrupt message. (I'm pretty sure.)

2. My screen went totally blank. (I'm sure.)

3. I attempted several cold boots to no avail (still no screen). It was hard to tell with no screen, but I don't think the machine was rebooting at all.

4. I called LE tech support. They advised me to pull the turbo board.

5. I pulled the turbo board.

6. Rebooted and everything worked fine again (at, alas, 4.77 MHz) and with the aforementioned intermittent HW error messages.

7. Called Orchid tech support.

8. They surmised that the board's "video chips" had failed.

9. I sent the board back to Orchid. (Several days pass.)

10. Orchid tech support called to tell me that my board was fine. They tried for days to duplicate my problem to no avail.

11. I'm now awaiting the return of my turbo board.

So, as you can see, I've had a traumatic computer experience and have yet to find the culprit. I've been using the turbo board for months with no problems. We'll really find some things out in a few days after I get the turbo board back and see if it works in the system. If it does, then I'll REALLY be paranoid. Maybe this whole thing was heat-related? In the meantime, I still get this weird HW-interrupt message once or twice a day.

ibm.pc/hardware #2740, from barryn (Barry Nance), Sat Apr 25 22:52:09 1987. A comment to message 2739.

Larry, how many COM ports do you have in your machine? Are they jumpered correctly for COM1/IRQ4 and COM2/IRQ3 (if you have two of them)?

ibm.pc/hardware #2742, from hamby, Sun Apr 26 13:53:04 1987. A comment to message 2740.

I have two COM ports. I took the lid off and checked how I have the jumpers configured. I did this according to Orchid's directions and also Microsoft's. (Remember, I have a bus mouse as well as the turbo board.) I yanked the jumper at IRQ2.

continued

American Semiconductor

Gives you the prices and products that have quickly made them,

SAY CHARGE IT! W/AMERICAN SEMICONDUCTOR CHARGE CARD

TOP GUN

Complete systems for Less than ANYBODY!
And we can FINANCE YOU!
Our revolving charge makes owning the system you want easy!
Over a $BILLION FINANCING of AVAILABLE!!

NOT A LEASE ★ YOU OWN IT!

★FREE!! FLIGHT SIMULATOR LIMITED TIME OFFER!!
WITH ANY COMPUTER PURCHASE

$29.mo.
TURBO XT MODEL #5301
• Selectable **4.77** & **8** MHz Processing Speed • **64**K RAM Memory • Bios • One **360**K Floppy Drive • Floppy Controller w/Cable • Eight Expansion Slots • PC/XT Compatible Keyboard
RETAIL VALUE **1099.**
OUR PRICE 499.

$39.mo.
TURBO XT MODEL #5302
• Selectable **4.77** & **8** MHz Processing Speed • **640**K RAM Memory on Main Board • Bios • **16** Bit **8088-2** CPU • One **360**K Floppy Drive • Multi I/O (w/Floppy Controller, Clock/Calendar, Parallel, Serial, & Game Port) • Eight Expansion Slots • PC/XT Compatible Keyboard
RETAIL VALUE **1599.**
OUR PRICE 739.

$45.mo.
TURBO XT MODEL #5303
• Selectable **4.77** & **8** MHz Processing Speed • **640**K RAM Memory on Main Board • Bios • **8088-2** CPU • One **360**K Floppy Drive • Multi I/O (w/Floppy Controller Clock/Calendar, Parallel, Serial & Game Port) • Eight Expansion Slots • One **10**MB Hard Drive (w/Controller) • PC/XT Compatible Keyboard
RETAIL VALUE **1999.**
OUR PRICE 1019.

$49.mo.
TURBO XT MODEL #5304
• **8** MHz Processing Speed • **640**K RAM Memory on Main Board • Bios • **16** Bit **8088-2** CPU • Two **360**K Half/Height Floppy Drives • Multi I/O (w/Floppy Controller, Clock/Calendar, Parallel, Serial, & Game Port) • One **20**MB Hard Drive (w/Controller) • TURBO/Normal Mode Either Software or Hardware Selectable • Eight Expansion Slots • PC/XT Compatible Keyboard
RETAIL VALUE **2499.**
OUR PRICE 1295.

$49.mo.
TURBO XT MODEL #5305
• **8** MHz Clock Speed • **640**K RAM Memory on Main Board • Bios • **16** Bit **8088-2** CPU • Two **360**K Half/Height Floppy Drives • Multi I/O (w/Floppy Controller, Clock/Calendar, Parallel, Serial, & Game Port) • **30**MB Hard Drive (w/controller) • TURBO/Normal Mode Either Software or Hardware Selectable • Eight Expansion Slots • PC/AT Compatible Keyboard
RETAIL VALUE **2999.**
OUR PRICE 1479.

$59.mo. EGA
TURBO XT MODEL #5306
• **8** MHz Processing Speed • **640**K RAM Memory on Main Board • Bios • **16** Bit **8088-2** CPU • Two **360**K Half/Height Floppy Drives • Multi I/O (w/Floppy Controller, Clock/Calendar, Parallel, Serial, & Game Port) • **20**MB Hard Drive (w/Controller) • TURBO Normal Mode Either Software or Hardware Selectable • Eight Expansion Slots • PC/XT Compatible Keyboard • IBM Compatible Enhanced Graphics Adapter (EGA) • High Resolution EGA Monitor
RETAIL VALUE **3899.**
OUR PRICE 1949.

$5.mo.
VIDEO GRAPHIC PACKAGES
MONOCHROME
COLOR
EGA ENHANCED
WITH MOST SYSTEM PURCHASES

HARD DRIVE KITS from 10 mb. to 360 mb.

$59.mo.
AT PORTABLE TURBO MODEL #5509
XT 640 RAM Memory • **AT 512** RAM Memory • 1/2 High **360** Floppy disk drive • **8088** CPU/**80286** CPU • RAM **640K** • Operating system: **CP/M86** & UCSD-P • Interface cards: multi I/O card, color graphics card or monochrome card • 9" Dual frequency monitor or monochrome monitor • Power: **135W** power supply (for XT) **200W** power supply (for AT) • AT/XT switchable keyboard (Cherry Switch) • Size: **48 cm** (W) x **44 cm** (D) x **19 cm** (H) • Weight: **14 kgs**
RETAIL VALUE **2995.**
OUR PRICE 1749.
AVAILABLE IN XT • MODEL #5309 • $49 mo.
RETAIL VALUE 2459 • **OUR PRICE 1249.**

$69.mo.
TURBO AT MODEL #5503
• **10** MHz Clock Speed • **512**K RAM Memory (**1**MB Option Available) • Bios • Intel **80286** Microprocessor • **1.2**MB Half/Height Floppy Drive • **40**MB Hard Drive (w/Controller) • Eight Expansion Slots • Serial/Parallel Adapter • AT Compatible Keyboard • Performance **16, 12, 10, 8, 6** MHz Available.
RETAIL VALUE **5999.**
OUR PRICE 2099.

$59.mo.
BABY AT TURBO MODEL #5507
• **6-8-10** MHz Processing Speed • **6** MHz • **640**K (Expandable to **1**MB on Main Board) • Bios • **80286** Based CPU • **360**K Half/Height Floppy Drive • Hard Drive (w/Controller) • Multi IO (w/Floppy Controller, Clock/Calendar, Parallel, Serial, & Game Port) • **20** MB Hard Drive (w/Controller) • AT Style Keyboard
RETAIL VALUE **3999.**
OUR PRICE 1759.

$59.mo.
TURBO AT MODEL #5501
• **512**K RAM Memory (Expandable to **1**MB on Main Board) • **80286** Based CPU • Bios • **1.2**MB Half/Height Floppy Drive • **20**MB Hard Drive (w/Controller) • Eight Expansion Slots • Parallel Port • AT Style Keyboard • Performance **16, 12, 10, 8, 6** MHz Available.
RETAIL VALUE **3999.**
OUR PRICE 1719.

$69.mo.
TURBO AT MODEL #5502
• **10** MHz Clock Speed • **512**K RAM Memory (**1**MB Option Available) • Bios • Intel **80286** Microprocessor • **1.2**MB Half/Height Floppy Drive • **30**MB Hard Drive (w/Controller) • Eight Expansion Slots • Serial/Parallel Adapter • AT Compatible Keyboard • Performance **16, 12, 10, 8, 6** MHz Available.
RETAIL VALUE **4499.**
OUR PRICE 1959.

$85.mo. NEW 386
MODEL #5701
• **16** MHz Processor Speed • Intel **80386** Micro Processor • **32** Bit architecture • Compatible with **8** MHz **80286** Hardware & Software • Phoenix **386** Bios • Four Speed Selection **(16, 8, 6, 4.77** MHz) • Relocation of Bios • EGA Bios to **32** Bit High Speed RAM for Lightning Execution • Real Time Clock • **4, 8 or 10** MHz **80287** Co-processor Socket • Standard **32** Bit High Speed Memory Board **1**MB of RAM Memory Installed, Connectors For Attaching Up to **10**MB of Memory • **1.2**MB Half/Height Floppy Drive • Eight Expansion Slots • Serial/Parallel Adapter • AT Compatible Keyboard
RETAIL VALUE **8999.**
OUR PRICE 3272.

CHEAPER PRICES? AMERICAN SEMICONDUCTOR had to make a choice between building our products as cheaply as possible and selling it as a "get-by" product, or building quality into our products for service, durability, and your long lasting enjoyment.
We know you would prefer to deal with a company that puts everything possible into its product, to make it the best. The best things are never the cheapest, and cheap things are seldom the best.
NO OTHER COMPANY CAN OFFER YOU A 5 YEAR WARRANTY ON ITS XT & XT TURBO MOTHER BOARDS...AND INSTANT CREDIT BESIDES!
"Our direct control, from R&D component selection to final assembly, enables us to maintain quality throughout the complete manufacturing process." THAT'S WHY WE SELL SO MANY!

President, American Semiconductor, Inc. Anthony R. O'Neill

INSTANT CREDIT NOW!

Even if you have a computer... We'll sell you add-ons from our **TOP QUALITY** products, and **FINANCE** them too!

MONITORS ARE ADDITIONAL. SURGE PROTECTOR/POWER DISTRIBUTION CENTERS ARE OPTIONAL AND AVAILABLE FOR ONLY $39.95

SAY CHARGE IT!
DD 3.95%
ORDER TOLL FREE!
800-237-5758 EXT. 823
CUSTOMER SERVICE (813) 961-5584
MPORT EXPORT
813) 961-9444
OPEN MON–FRI 8 AM–7 PM
OPEN SATURDAY 9 AM–5 PM (EST)
CORPORATE HEADQUARTERS: 16520 N. FLORIDA AVE., LUTZ, FLORIDA 33549, (813) 961-9444

DEALERS! call for the up to minute prices for **DRAM'S, 8087's, EXPANSION CARDS, IC'S** and much, much more!

1-800-825-SAVE

NORTHEAST REGIONAL SALES OFFICE 1-301-933-3523
WASHINGTON, D.C. AREA 1-800-942-9488

OFFICES NOW OPEN: TAMPA – MIAMI – LOS ANGELES – WASHINGTON, D.C. – TAIPEI, TAIWAN – TOKYO, JAPAN

PRICES SUBJECT TO CHANGE DUE TO AVAILABILITY AND MARKET FLUCTUATIONS. VOID WHERE PROHIBITED. $25.00 CREDIT APPLICATION FEE

This means I have no jumper connected for IRQs 2, 4, 5, and 7. Interestingly, IRQ2 is supposed to control my clock/calendar, and yanking this jumper was supposed to disable the clock/calendar. It works the same now as it did before. One other note: This configuration worked fine for several months. If I had my jumpers set incorrectly, wouldn't the problem have presented itself immediately?

Oh yeah, the board for the mouse and the turbo have jumpers on them that control which interrupt they will utilize. Since all worked well and my crash was so dramatic (blank screen, no boot, etc.) and cleared upon pulling the turbo board, does it seem reasonable to assume that a simple "friction" connection (i.e., the board slot connectors) could have disconnected due to expansion or contraction? Of course, every time I have a problem, I think it's heat-related.

---

ibm.pc/hardware #2743, from barryn, Sun Apr 26 16:19:17 1987. A comment to message 2742.

Well, if the COM ports are jumpered and set up correctly, and if it worked for months beforehand with no problems...I'm left scratching my head over this one.

---

ibm.pc/hardware #2752, from hamby, Mon Apr 27 22:17:37 1987. A comment to message 2743.

At the risk of really beating a dead horse, and if the subject of my mysterious intermittent "Unexpected HW interrupt at..." hasn't become boring to the extreme, they have now disappeared! (No, I haven't changed anything, and the turbo board is not yet reinstalled.) Since none of us was able to figure out why they appeared, I don't imagine their disappearance is going to help us understand what it was all about. Sure feel confident in this machine. Uh huh.

---

ibm.pc/hardware #2753, from barryn, Mon Apr 27 22:27:54 1987. A comment to message 2752.

Mysteries are never boring (especially when it's your own machine!). If you figure out what's going on, be sure to drop a note here about it. I'd sure be interested.

---

ibm.pc/hardware #2754, from hamby, Mon Apr 27 22:32:09 1987. A comment to message 2752.

How ironic and at once embarrassing! As soon as I left the previous message, I signed off of BIX, and, while attempting to sign onto another service, I got "Unexpected HW interrupt at..." this time at a different address than before (OC at 01AD:138F). I'm starting to detect (maybe) a pattern to these occurrences. They either appear while I'm just sitting in DOS doing nothing or while on-line or attempting to get on-line. Might be COM-port-related, as suspected. (Imagine the sound of hair being pulled out.)

---

ibm.pc/hardware #2755, from barryn, Mon Apr 27 22:46:45 1987. A comment to message 2754.

Larry, what communications program are you using? That might provide a clue.

---

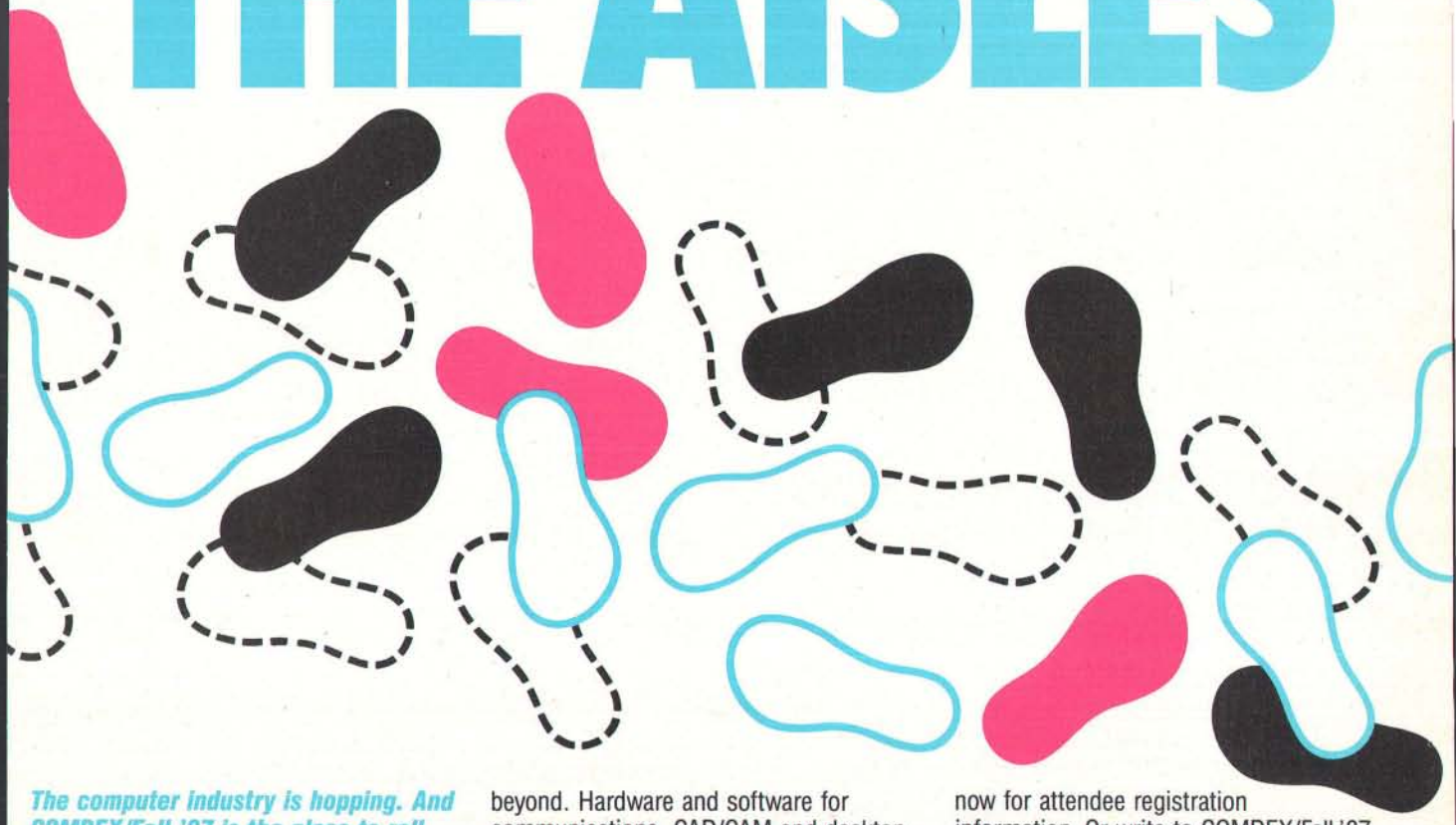
ibm.pc/hardware #2758, from hamby, Tue Apr 28 07:53:23 1987. A comment to message 2755.

I use Mirror (a Crosstalk clone) and also an odd, custom program that links "Managing Your Money" to Chase Manhattan Bank. This is a rather glitchy program anyway. Might be a clue.

continued

Circle 310 on Reader Service Card (Dealers: 311)

DANCE IN THE AISLES



The computer industry is hopping. And COMDEX/Fall '87 is the place to roll back the rug, kick up your heels, and get down to business with more than 1300 exhibitors in a "sold out" show.

COMDEX/Fall '86 and COMDEX/Spring '87 proved that the industry had regained its form. The former signaled the resurgence, and the latter became the most successful Spring show ever, with over 52,000 attendees.

The perfect partner for VARs, VADs, distributors, OEMs, and other resellers, COMDEX/Fall '87 pairs you with suppliers of the newest products and services that will vitalize your sales for 1988 and beyond. Hardware and software for communications, CAD/CAM and desktop publishing, multi-user systems, micro-mainframe integration, workstations, local area networks—you can take a turn with all the liveliest opportunities of the season.

And you 'll step up your sales momentum through such Conference exclusives as field reports from users and resellers on IBM 's new generation of desktop machines, Apple 's Macintosh series, and through seminars on desktop publishing, CAD/CAM and corporate connectivity.

COMDEX/Fall '87 is where the industry is hopping. Fill out and send in the coupon now for attendee registration information. Or write to COMDEX/Fall '87 Attendee Registration, 300 First Avenue, Needham, MA 02194.

COMDEX/Fall has me dancing in the aisles!

- ☐ Send me complete attendee information, including registration form, hotel and travel discounts.
- ☐ Send me exhibitor wait list information.
- ☐ Have a Sales Representative call me.

Name_____

Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Return to: COMDEX/Fall '87 Attendee Registration
300 First Avenue, Needham, MA 02194 BY1087

COMDEX®/Fall '87

November 2–6, 1987 · Las Vegas · Nevada

Produced by ☒ THE INTERFACE GROUP, Inc.

Circle 133 on Reader Service Card

ibm.pc/hardware #2761, from greenber (Ross Greenberg), Tue Apr 28 10:30:42 1987. A comment to message 2758.

Sounds to me as if the interrupts are not being restored properly by one of your two programs. Try the following experiment. Boot your machine, run Debug, and type "d 0:30" in response to the "-" prompt. This will give you the interrupt vector address for the serial port. Do a print screen onto your printer. Now run each of your comm programs and exit from them as you normally do. Go back into debug and enter that "d 0:30" again and take a look at the hex numbers that print out. Are they the same as before you ran the code? If so, then ignore this message; the problem lies elsewhere. If, however, the numbers have changed, they indicate some massive nastiness going on. Do *not* continue using the program in question; there is a possibility, albeit a slim one, that an unwanted character coming in the serial port might cause damage to something. Possibly, those numbers might be the same, indicating that at least part of the mystery work is done. It could always be unmasked interrupts or a whole bunch of other things. I'd be more than interested in seeing what numbers Debug comes out with -- both before and after. My bet's on the Managing Your Money program...

ibm.pc/hardware #2757, from bomb (Jerry McReynolds), Tue Apr 28 04:25:15 1987. A comment to message 2754.

Larry, does this problem with the "Unexpected HW interrupt" occur when the phone rings? Sounds a little strange, doesn't it? You say that the problem occurs while at the DOS prompt or when using the COM port. Have you tried to COPY CON COM1 or COM2 to see if you could reproduce the problem? Another idea: Have you checked the interrupt vector contents after boot-up and then again after using your communications program? The communications program might not be restoring vectors. I remember when that same problem (oversight) bit me in the rump.

ibm.pc/hardware #2759, from hamby, Tue Apr 28 08:01:39 1987. A comment to message 2757.

Jerry, if you'll tell me how, I'll check the interrupt vector contents. Never done that one before, but I'm sure I'll be able to figure it out if you'll point me in the right direction.

ibm.pc/hardware #2760, from hamby, Tue Apr 28 08:17:55 1987. A comment to message 2759.

Aha! I was just able to duplicate the problem twice (but not three times) in a row. It happened when I was using the aforementioned Chase Manhattan Bank home-banking communications software. I got the HW-interrupt error message as soon as the program tried to use the COM1 port and before it actually had the modem begin dialing. I tried my diagnostics program out to check the COM ports also. I was able to get the error message once out of 10 tries so far.

ibm.pc/hardware #2763, from barryn, Tue Apr 28 19:06:02 1987. A comment to message 2760.

Larry, I think you and Jerry have hit on the problem. It appears the home-banking communications software is not resetting the COM port properly when it exits.

ibm.pc/hardware #2764, from hamby, Tue Apr 28 23:15:43 1987. A comment to message 2763.

Man, you guys are GOOD. It IS the Managing Your Money/Chase Manhattan communications software that is causing the problems.

Further evidence to follow, but first the results of the debug session:

First 4 bytes before any comm programs:

63 FE 0C F0

Same 4 bytes after the comm MYM/Chase program:

5B 4D EB 1C

The numbers changed only after I used the MYM comm program. Mirror caused no problems at all. Earlier today after we started to suspect the MYM/Chase program, I tried the following and got these horrifying results: I ran the suspect comm program, exited, and ran a diagnostics program to check specifically the COM1 port. My diagnostics program happens to display the date and time. When I hit the "go" button to execute the test, I got a HW-interrupt message, and the date and time began clicking erratically through different time zones and centuries. I hit Ctl-Alt-Del to get out of this, and the system hung with the screen blank. The only thing that got me back to the beginning was a cold boot. I now know that what I thought was a bogus turbo board was nothing of the kind. As Mr. Greenberg suggests, the MYM/Chase software is causing serious harassment to my machine. Way back when I had my screen blank out after using this program with my turbo board installed, not even a cold boot would restore the screen. I had to yank the board. One more thing: After using the comm program, I couldn't do a print screen of the debug results. Print screen wouldn't work. I called Chase Manhattan tech support and was told to cold-boot after using the program in order to clear system memory.

Well, now that I've gotten used to the idea of home banking, I guess I'll have to quit. I wonder why they don't just fix their program? Surely there are others who are having the same problem. Is there any way other than trial and error to determine the health and integrity of my system at this point? Thanks so much.

ibm.pc/hardware #2765, from dmick, Wed Apr 29 01:47:06 1987. A comment to message 2764.

Instead of dumping the program, get "tsr21.arc" from IBM.ARC. Run MARK.COM before running the program, and then run RELEASE.COM afterward. It's normally used to dump TSR programs, but one of its functions is to restore all the interrupt vectors as they were before you ran MARK (MARK saves 'em; RELEASE restores 'em). It's pretty foolproof.

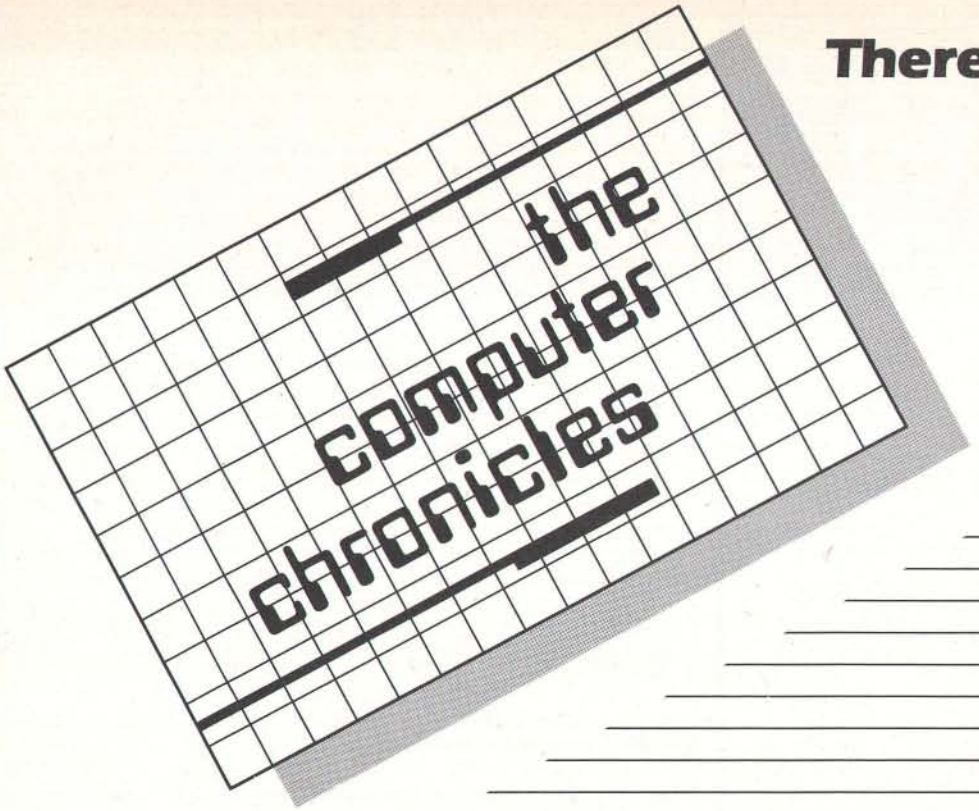
That's a pretty silly way to go about the process. It's *very* easy, in assembly language or a high-level language, to restore the interrupt after you've used it. That's nothing but completely irresponsible programming. I wouldn't worry about your system...the problem will most likely go away if you reboot or if you use MARK/RELEASE. At least, I'd be amazed if it didn't go away.

ibm.pc/hardware #2766, from bomb, Wed Apr 29 02:45:02 1987. A comment to message 2764.

"GOOD," yeah, maybe... experienced most definitely... Glad to hear that you found the culprit! See, computers *are* really fun, aren't they? If you're calling that a bad crash, well, my little blue has had too many bad crashes to count, and it still keeps ticking (a bit slower, though). Did you smell anything funny after any of the crashes? I can remember taking out 11 computers at the same time, one 8088-based system talking to ten 8039-based systems. The system used 24VDC solenoids to move deflectors. I activated the solenoid with a 100-microsecond pulse of 70VDC and held it closed with 20VDC. Well, in that short window of time the code went somewhere (not where it was supposed to), and it never released the 70VDC. Needless to say,

continued

There's One More Computer Program You Need



THE COMPUTER CHRONICLES, THE ONLY NATIONAL TELEVISION SERIES AIMED AT COMPUTER USERS, OWNERS, EDUCATORS AND COMPUTER INDUSTRY PROFESSIONALS. NOW IN ITS FOURTH SEASON ON PUBLIC TELEVISION.

CO-HOSTED BY GARY KILDALL AND STEWART CHEIFET, WITH COMMENTATOR GEORGE MORROW, THE COMPUTER CHRONICLES KEEPS YOU UP-TO-DATE ON THE EVER CHANGING WORLD OF COMPUTING.

THE COMPUTER CHRONICLES, PROGRAMMED WEEKLY BY COMPUTER PROFESSIONALS FOR COMPUTER USERS.

The Computer Chronicles is funded by **Leading Edge** and McGraw-Hill's **BYTE** magazine.

LEADING EDGE®

Gary Kildall

Stewart Cheifet

George Morrow

TOPICS THIS SEASON INCLUDE:

EDUCATIONAL SOFTWARE • RISC • UTILITIES
DESKTOP PUBLISHING • GUIDE TO MACROS
RAM RESIDENT SOFTWARE • ON-LINE DATA BASES • MODEMS
PROJECT MANAGEMENT SOFTWARE • CD-ROMS
ARTIFICIAL INTELLIGENCE • PERSONAL CAD

PLUS...

RANDOM ACCESS

A WEEKLY NEWS SEGMENT DESIGNED TO KEEP YOU INFORMED ABOUT THE LATEST DEVELOPMENTS IN THE COMPUTER INDUSTRY.

The Computer Chronicles on PBS is a co-production of WITF/Harrisburg and KCSM/San Mateo.

24VDC solenoids don't last too long with 70VDC applied. It probably took 20 seconds to notice the smell of burning solenoid, another second or so to react, too late, before I could reach the Big Red Switch, poof, poof, poof,... wisp of smoke... and a CRACK later. Well, that's all she wrote, the solenoid shorted, causing the TIP117 driver transistor to short, causing the 75468 to short, putting +70 volts on a +5 volt signal supplied by an 8255A, the 8255A went through meltdown putting +70 on the bus, and it was all over but the crying. BTW, not a single fuse blew! Anyway, I'm glad we could help.

---

ibm.pc/hardware #2767, from greenber, Wed Apr 29 08:27:40 1987. A comment to message 2764.

Glad to see we could be of assist. There are a couple of alternatives now. The first would be to junk the program, which is the easiest. Moving on to techie stuff, you can make a little program that will save and restore these interrupt vectors before and after you run the blasted program. There's a little more to this than meets the eye, since you have to twiddle with some bit ports to actually turn interrupts on the given COM port off. There is Dan Mick's suggestion, using the MARK and RELEASE package, which will restore the interrupt vectors *but* will not turn the interrupts off.

---

ibm.pc/hardware #2768, from barryn, Wed Apr 29 09:50:16 1987. A comment to message 2764.

Larry, as Dan suggests, using MARK before running the home-banking program and then issuing a RELEASE afterward will restore the interrupt vectors to their proper values. However, it sounds like the COM ports are still "active" when the bank-communications program finishes. To reset both COM ports to an inactive state, try running the following program after the home-banking program but before RELEASE (in other words, and perhaps in a .BAT file, run things in this order: 1) MARK, 2) the home-banking program, 3) RESET.COM (the TP program that follows), and 4) RELEASE).

```
100   rem
200   rem          a program to deactivate COM ports
300   rem
400   MCR% = &H03FC
500   IMR% = &H0021
600   IER% = &H03F9
700   Out MCR%, 0
800   Out IMR%, Inp(IMR%) OR &H0010
900   Out IER%, 0
1000  MCR% = &H02FC
1100  IER% = &H02F9
1200  Out MCR%, 0
1300  Out IMR%, Inp(IMR%) OR &H0008
1400  Out IER%, 0
1500  End
```

---

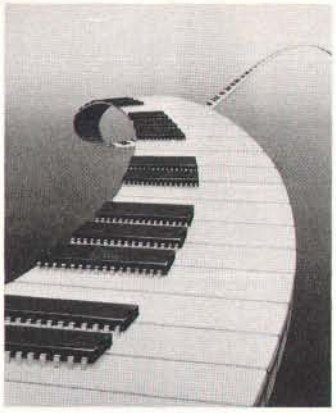
ibm.pc/hardware #2775, from hamby, Wed Apr 29 23:24:23 1987. A comment to message 2768.

IT WORKS!!!! I've got the whole little bundle in a couple of batch files. I call up the comm program with one keystroke. It MARKS the memory position and then starts the comm program. After I exit the program, I hit one key and it RELEASES the memory and then runs the program, which resets the COM port. I know it works, because before I was always left with my modem in auto-answer mode until I entered another comm program and turned it off. This, of course, was a result of the unreset COM port. Let's hope there's no other weirdness now from this bizarre

continued

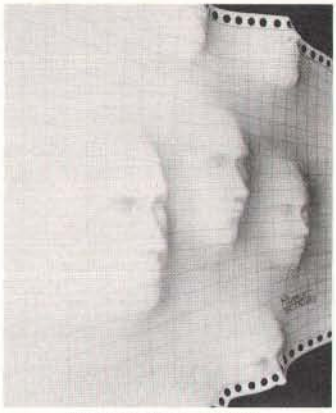
BYTE Limited Editions

#E $55



Chips of Note

#F $55



Human Dimensions

Striking 16″ × 20″ Limited Edition Prints from the pages of Byte. Each print is signed and numbered by the artist, Robert Tinney.

Limited Edition Classics

You've seen them on the cover of Byte — now enjoy these delightful images as stunning limited edition prints! Each print pictured here is published in an edition strictly limited to only 1000 signed and numbered prints, and each is accompanied by its own Certificate of Authenticity.

These gorgeous reproductions are printed on select 100% cotton fiber stock; this is a museum grade acid-free paper, highly resistant to yellowing and cracking. You will be assured of a print which will retain its color and beauty for generations.

Price and Shipping

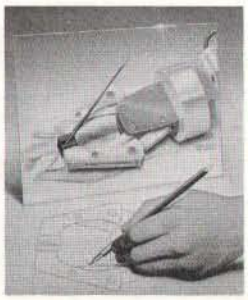
The price of Byte Limited Editions, which depends on the number of unsold prints in each edition, is shown above each print pictured here. In addition, a 15% discount is available if you order two or more prints.

Your prints will be shipped flat, usually within a week of our receipt of the order. Shipping is via UPS Blue Label.

Guarantee

Ship your prints back to us within 30 days of your order, and you will be given a complete, no-questions-asked refund.

#A $60



Intelligent Reflections

#B $55

Storage Space

#C $55

Technological Breakthrough

#D $55

Number Crunching

Yes! Send me the following Byte Limited Editions.

QTY.	#	TITLE	AMOUNT
			$
			$
			$
			$
			$
			$
		Deduct 15% if ordering two or more prints.	$
		Shipping: $4 ($20 overseas).	$
		TOTAL	$

☐ Please send your COLOR brochure

☐ I have enclosed U.S. check or money order.
☐ C.O.D. (via UPS—stateside orders only)
☐ VISA ☐ MasterCard ☐ American Express

Card #: _____

Expires: _____ Signature: _____

Ship my Print(s) to:

Name: _____

(Business): _____

Address: _____

City: _____

State: _____ Zip: _____

mail this coupon to:
Robert Tinney Graphics
1864 North Pamela Dr.
Baton Rouge, Louisiana 70815

For VISA, MasterCard or American Express orders, or for more information

Call 1-504-272-7266

program. Now, for "neatness and appearance," is there any way that I can get from BASIC's "OK" prompt back to DOS automatically, or do I have to type "system" myself? Thanks again. You are obviously a man of rare caliber and breeding.

---

ibm.pc/hardware #2776, from barryn, Wed Apr 29 23:27:42 1987. A comment to message 2775.

Terrific, Larry! Glad it works. As to the "OK" prompt in BASIC, just replace the End statement with a System statement, and it'll return to DOS automatically.

SETTING UP A +640K PC AT RAM

---

ibm.at/hardware #1687, from jcrouch (Jack Crouch), Sun Jun 7 23:49:32 1987.

Can anyone help me with what will probably seem a simple problem? I have an AT clone with 1 Mb of RAM. Is there any way to use the RAM above 640K for anything, such as a RAM disk? My venture into the MS-DOS manual only confused me more than before. I got the impression that only RAM (like EMS) above 1 Mb could be used. Help!

---

ibm.at/hardware #1688, from irae (Ira Emus), Mon Jun 8 00:41:45 1987. A comment to message 1687.

You should be able to use at least part of it as a RAM disk with vdisk.sys. Add this to your config.sys:

device=vdisk.sys 384 /e

---

ibm.at/hardware #1692, from sbrodie (Scott Brodie), Tue Jun 9 22:17:31 1987. A comment to message 1687.

It depends on your clone. Apparently, the memory mapping of the RAM beyond 512K is not standardized, as the original IBM ATs had only 512K. Most clones allow you to chose between two or more configurations, usually by means of jumpers or DIP switches on the motherboard. You'll have to check the hardware manuals that came with your machine (though these are often little or no help). Many clones, unfortunately, give you only the Hobson's choice between allocating 512K as regular memory and 512K as extended memory (which would be accessible under MS-DOS only via the DOS RAM-disk utility), or allocating 640K as regular memory (maximizing the memory available to regular DOS applications), leaving the remaining 384K UTTERLY INACCESSIBLE! You may be able to use 64K RAM chips in place of the 256K chips that fill out the upper 512K, bringing the RAM on the motherboard to an even 640K; and use the 256K chips on an EMS or other memory-expansion board, where they might actually be of some use. I have seen a few clones that do allow the "obvious" allocation of 640K to DOS, and 384K as extended memory, suitable for a small RAM disk. If you select the 512/512 allocation, you should be able to come up to 640K for DOS using the first bank of a memory-expansion card, many of which (such as the Intel AboveBoards) come with 128K installed for just this purpose.

MODEL 60: PROBLEMS AND IMPRESSIONS

---

ibm.ps/model.50 #281, from bfernandez (Brian Fernandez), Sat Jun 27 23:25:29 1987.

My company has two Model 60s, and we've noted the following problems and behavior that may be of interest:

1. The IBM memory-upgrade kit does not fit on the motherboard properly, and the system does not react well to its installation (it does not use the space). If you install expanded memory, it ignores the motherboard and goes to the installed additional memory. Thus, if you install an incremental 1 Mb, you do not get 2 usable, but only 1. You must go to Orchid to get extended memory that works -- the IBM board will not be out until October, so until then there will be no memory upgrades. This obviously has implications for speed and running a relational DBMS under Windows, for example.

2. Some of the keyboards do not use the right Ctl & Alt with some programs.

3. The Quietwriter III with sheet feeders is a super machine!

4. We have not been able to use software copy programs to break the 5.25-to-3.5 transfers successfully in the event Assign A=B doesn't work. There is some problem with this we do not know about yet.

5. When booting you get all kinds or error codes (and a frozen system) if the software isn't properly copied onto C:. To cure, just remove the installed option and install proper software before booting!

6. The IBM internal modem, while restricted to 1200 bps, seems to work just like a Hayes with Smartcom, as well as the recommended Crosstalk.

7. We have found the ibm.cache + access time on the disk to enhance the speed considerably -- reading the clock speed or Norton reading is a totally unreliable measure of the real speed under loading. We are not talking serious LINPACKs, but it is a very fast machine for programs requiring heavy disk access.

8. If you lose your keys, as we did on installation, a locksmith will have no trouble drilling the old one out and installing a new one, but tape the system vents before he drills so metal particles do not get into the machine.

9. Our conclusion is that the 60 is a really good, solid box with a lot of future growth potential that, with incremental memory (which it badly needs and cannot get at this point), will operate very well in a windows or DOS or OS/2 environment. We plan to buy a number more and standardize on it.

---

ibm.ps/model.50 #283, from kkonnerth (Karl Konnerth), Tue Jun 30 23:31:54 1987. A comment to message 281.

I am also very happy with the Model 60 so far. However, I don't believe there is a motherboard memory-expansion option - it all has to be done with expansion cards. What were you doing? Also, Fort Software (in Kansas) and Vericomp (in San Diego) both offer true EMS drivers for the plain old IBM extended-memory boards. They take advantage of a bank-switching feature that was designed to map bad 16K segments of memory out of the address space, and they are supposed to run as fast as a true (E)EMS board - unlike EMS emulators for the AT extended memory. Also, Central Point advised me to first break copy protection on the 5.25, and then copy to 3.5. I'm just trying to avoid CP software (except 1-2-3, where I am patiently waiting for an upgrade). Finally, I haven't seen much of the problem you describe with the Ctl and Alt keys - what software does it occur with?

---

ibm.ps/model.50 #287, from swnev (Scott Neville), Mon Jul 6 23:42:23 1987. A comment to message 283.

None of the programs I use work with the right Alt key. These include Turbo Pascal, BASICA, Brief, PC-Write, and a whole slew of other programs.

continued

Announcing BYTE's New Subscriber Benefits Program

Your BYTE subscription brings you a complete menu of the latest in microcomputer technology every 30 days. The kind of broad-based objective coverage you read in every issue. *In addition*, your subscription carries a wealth of other benefits. Check the check list:

BONUSES

- ☑ ***Annual Separate Issues:*** In addition to BYTE's 12 monthly issues, subscribers also receive our annual IBM PC issue free of charge, as well as any other annual issues BYTE may produce.
- ☑ ***BYTE Deck:*** Subscribers receive five BYTE postcard deck mailings each year—a direct response system for you to obtain information on advertised products through return mail.
- ☑ ***Reader Service:*** For information on products advertised in BYTE, circle the numbers on the Reader Service card enclosed in each issue that correspond to the numbers for the advertisers you select. Drop it in the mail and we'll get your inquiries to the advertisers.
- ☑ ***TIPS:*** BYTE's Telephone Inquiry System is available to subscribers who need *fast response*. After obtaining your Subscriber I.D. Card, dial TIPS and enter your inquiries. You'll save as much as ten days over the response to Reader Service cards.
- ☑ ***BYTE's BOMB:*** BYTE's Ongoing Monitor Box is your direct line to the editor's desk. Each month, you can rate the articles via the Reader Service card. Your feedback helps us keep up to date on your information needs.

- ☑ ***Subscription Service:*** If you have a problem with, or a question about, your subscription, you may phone us during regular business hours (Eastern time) at our toll-free number: 1-800-423-8912 (in N.J., 201-981-1963). You can also use Subscription Service to obtain back issues and editorial indexes.

PAID SERVICES

- ☑ ***BIX:*** BYTE's Information Exchange puts you on-line 24 hours a day with your peers via computer conferencing and electronic mail. All you need to sign up is a microcomputer, a modem, and telecomm software. For further information and cost call 1-800-227-BYTE.
- ☑ ***Program Listings:*** Listings of programs that accompany BYTE articles are now available on BIX, on disks or in quarterly printed supplements (see reply cards in this issue for cost information), or call 1-800-258-5485.
- ☑ ***Microform:*** BYTE is available in microform from University Microfilm International in the U.S. and Europe. See Contents page for cost information.

DISCOUNTS

- ☑ 13 issues instead of 12 if you send payment with subscription order.
- ☑ One-year subscription at $22 (50% off cover price).
- ☑ Two-year subscription at $40.
- ☑ Three-year subscription at $58.
- ☑ One-year group subscription for ten or more at $18.50 each. (Call or write for details.)

TOLL-FREE NUMBERS FOR YOUR CONVENIENCE:

Subscriptions & Back Issues:
1-800-423-8912 (in N.J., 201-981-1963)

BIX: 1-800-227-BYTE

Program Listings Orders:
1-800-258-5485

And . . . welcome to BYTE country!

BYTE
THE SMALL SYSTEMS JOURNAL

McGraw-Hill

The diagnostics on the reference disk recognize the right Alt key, and the keyboard tutorial on that disk performs as it should using the right Alt key.

I will run the keyboard up to my local dealer as soon as I get the chance and see if the same thing happens on their system.

---

ibm.ps/model.50 #286, from nickbaran (Nick Baran, BYTE), Sun Jul 5 22:32:05 1987. A comment to message 281.

There have been reports of these boot errors from a number of sources. Which software must be "installed correctly on drive C:" to avoid these errors?

64-HEAD HARD DISKS? THE GAME'S AFOOT

---

ibm.ps/model.80 #100, from awright (Mark Garetz), Fri Jun 26 01:24:19 1987.

Re: The hard disk in the IBM PS/2 Model 80 having 64 heads.

This seems unlikely, especially given the poor access time. Sounds like a bug in the program reporting the number of heads, *or* in an effort to control the add-on drive market, IBM has built a drive with an interface that has 6 binary-coded head-select lines but doesn't really have that many heads in the actual drive. A processor in the drive electronics could easily translate to the actual number of heads.

---

ibm.ps/model.80 #102, from schin (Sam Chin), Fri Jun 26 10:59:38 1987. A comment to message 100.

Not only did Coretest 2.7 report 64 heads, but when I low-level-formatted the disk using IBM's Model 80 utilities, they counted 64 heads. The DOS 3.3 Format program also counts 64 heads. (The 3.2 and 3.3 Format programs list the head and track as they are formatting.) I know it sounds unlikely for it to have 64 physical heads, but that would account for the phenomenal 800K-byte/sec transfer time.

---

ibm.ps/model.80 #105, from matt.trask (Matt Trask), Fri Jun 26 16:23:27 1987. A comment to message 102.

One of the tricks that is played with ESDI drives under DOS is logical to physical mappings of the heads or sectors to support DOS's assumptions (limitations?) about what a drive can have. F'r instance, both the Western Digital WA5 controller and the Omti 8621 can change a 34-sector/track drive into a 17-sector/track drive with twice as many cylinders. Something like this may be used to cause the mysterious 64 heads.

---

ibm.ps/model.80 #103, from matt.trask, Fri Jun 26 16:16:54 1987. A comment to message 100.

Don't know that I can comment on that one. I've only spent a half hour with a Model 80 so far. Sounds like someone's software may be making ST-506 assumptions about the ESDI drives, though.

---

ibm.ps/model.80 #120, from mvose (Michael Vose, BYTE), Wed Jul 1 10:01:00 1987. A comment to message 103.

Yes, the Model 80's disk controller does use relative block addressing and tricks MS-DOS into thinking that there are 64 heads. There are 64 *logical* heads and, apparently, a device driver to map logical heads to physical heads.

IBM is supposedly preparing a fixed disk technical reference manual that explains all this stuff. (I got my info from some off-hand comments made by some IBM engineers milling around when I ran some Model 80 benchmarks for BYTE on a visit to Boca.) ■

THE BUYER'S MART
A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

RATES: 1x—$475 3x—$450 6x—$425 12x—$375
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters maximum), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due 2 months prior to issue date. For example: October issue closes on August 1. Send your copy and payment to THE BUYER'S MART, BYTE magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Mark Stone at BYTE 603-924-3754.

ACCESSORIES

FREE CATALOG
Thousands of parts and new surplus electronic parts at super low prices. **FAST ORDER PROCESSING AND SHIPPING** (95% of all orders shipped within 48 hours).
CALL OR WRITE FOR A FREE CATALOG. . .
ALL ELECTRONICS CORPORATION
POB 20406, Los Angeles, CA 90006-0406
1-800-826-5432

Inquiry 650.

SOFTWARE PACKAGING, DISKS
Cloth binders & slips like IBMs. Vinyl binders, boxes, and folders—many sizes. Disk pages, envelopes & labels. Low qty. imprinting. Bulk & branded disks. Much More! Low prices. Fast service. Call or write for FREE CATALOG.
Anthropomorphic Systems Limited
376-B East St. Charles Road
Lombard, IL 60148
1-800-DEAL-NOW (312) 629-5160

Inquiry 651.

AT LAST! A RIBBON INKER JUST FOR YOUR EPSON
Why buy new ribbons when you only use the ink? For just pennies each inking, this motorized inker provides perfect print quality. For any Epson compatible fabric ribbon. FREE 4 oz. bottle black ink, roller & cover. **Epson Ribbon Inker $52.95 Imagewriter I & II Inker $49.00.** Ship 24 Hr. Moneyback Guarantee. Check/M.O. Visa/MC. $1.50 S&H. Ohio add 6.5% tax.
BEDE TECH 800-772-4536
8327 Clinton Rd., Cleveland, OH 44144

Inquiry 652.

RE-INK FABRIC RIBBONS
Cut ribbon cost by using Borg Ribbon Inkers. Do all cartridge ribbons with just one inker. Choose from 3 models. Manual E-Zee Inker — **$39.50**
Electric E-Zee Inker — **$89.50**
Ink Master (Electric) — **$159.00**
1000's of satisfied users in 5 years. Moneyback guarantee.
BORG INDUSTRIES
525 MAIN ST., JANESVILLE, IA 50647
1-800-553-2404

Inquiry 653.

Self-Inking Printer Ribbon
For users of **Okidata** and other open spool ribbon printers. Controlled Printout Devices are a new kind of printing ribbon that re-ink themselves, and will last 15 times longer than the ribbon you are now using. For further information please call or write.
CONTROLLED PRINTOUT DEVICES, INC.
POB 869, Baldwin Rd., Arden, NC 28704
(704) 684-9044

Inquiry 654.

ACCESSORIES

COMPUTER PROTECTION
• UPS • LINE CONDITIONERS • ISOLATORS
• MODEM PROTECTORS
• AC POWER INTERRUPTERS
— HUNDREDS OF HINTS & PRODUCTS —
FREE CATALOG 1-800-225-4876
ELECTRONIC SPECIALISTS, INC.
171 So. Main St., POB 389, Natick, Mass 01760
1-800-225-4876

Inquiry 655.

FREE CATALOG
Diskettes & Acc • Dust Covers • Furniture • Data Cartridges • Plotter Pens • Clean'g Supl • Tapes & Acc • Ribbons • Printers • Computer Paper • Copier Supplies • Surge Prot • Cables & Acc • Print Wheels • MUCH MORE!
Call, write or circle inquiry card for a FREE Catalog
GAAN COMPUTER SUPPLIES
186 B East Sunnyoaks, Campbell, CA 95008
(800) 523-1238, In Calif. (408) 370-6747

Inquiry 656.

★ COMPUTER VOLUME CONTROL ★
At last. . . no more annoying BEEPS! Quiets games too! Adjust volume anytime from a faint whisper to maximum. Installs easily, directly to speaker wires with solderless terminals.
Only $29.95 ppd or 2 for $49.95.
VISA/MC/Check or M.O. AZ add 6.7% tax.
INNOVATIVE COMPUTER SOLUTIONS, INC.
2929 N 44th St., #400, Phoenix, AZ 85018
(602) 946-4743

Inquiry 657.

DIABLO 630 SHEET FEEDER AUTOMATIC 2-TRAY MINT — ONLY $400!!
Prints all first pages on letterhead and all other pages on blanks automatically. Feeds thousands of consecutive pages without a misfeed. Printers also available.
Quality Discount Computers
135 Artistview Drive, Wellington, NV 89444
(702) 465-2473 Ext. 120

Inquiry 658.

ARTIFICIAL INTELLIGENCE

NEURAL NETS
Simulation Software illustrating basic functions of neural nets. (See article by **Kosko** in BYTE September '87 for description of one type of net.) Diskette contains simple net code and references to the neural net field. $29.95 Visa/MC/check.
FAX GROUP
P.O. Box 477, Troutville, VA 24175
703-992-5200

Inquiry 659.

BAR CODE

BAR CODE MADE EASY
PERCON® E-Z-READER™ keyboard interfaces and multiuser RS-232 models make it easy to add bar code to virtually any computer/terminal WITHOUT SOFTWARE MODIFICATION. Immediate shipping. Two year warranty. Bar code printing software available. Call for details on fast, accurate, easy data entry. Substantial reseller discounts.
PERCON®
2190 W. 11th St., Eugene, OR 97402
(503) 344-1189

Inquiry 660.

READ & PRINT BAR CODES
Internal unit (short-card for IBM PC/XT/AT/compatibles) or RS-232 Dual Port unit: **both work with all keyboards and software.** Includes stainless steel wand or LASER gun. User-friendly Bar Code and Text printing software with format/size flexibility.
Seagull Scientific Systems
601 University Ave., Suite 150, Sacramento, CA 95825
(916) 386-1776

Inquiry 661.

DATA INPUT DEVICES
Bar Code & Magnetic Stripe Readers for microcomputers & terminals, including IBM PS/2 & others, DEC, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. Low cost bar code print programs & magnetic encoders are also available. GSA approved.
TPS Electronics
4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA

Inquiry 662.

PRINT BAR CODES & BIG TEXT
Print Labels with Large Text and/or bar codes on PC with Epson/Oki/IBM LaserJet printers. Text to 1"x1" reads at 50 ft. Bar Codes: Code 39, 2 of 5, UPC/EAN, MIL-STD, AIAG. Flexible format/size, Reversals. File Input, Menu-driven $279, Other menu-driven programs for bar codes $49-$129.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938
See our ad on page 207

BAR CODE READERS
PC/XT/AT Bar Code Reader attaches as 2nd keyboard, reads bar codes as keyed data. One model converts to external mounting via velcro or slot mounting in PC — $385. RS-232 Model—$399. Rugged metal wand, reads UPC, EAN, 2 of 5, Code 39, etc. Same day ship. 1 year warranty. 30 day $$ back guarantee.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 *See our ad on page 207*

THE BUYER'S MART

BAR CODE

BAR CODES/BIG TEXT FROM YOUR PROGRAM
Add bar codes and/or big graphics text to your program. Print from inside of dBASE, BASIC, C, any MS-DOS language or even a word processor. Bar codes: UPC-A, UPC-E, 2 of 5, and Code 39. Big text in wide and narrow sizes .5", .3" and .2" tall. Prints on Epson/Oki/IBM LaserJet printers $179-$239.

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938
See our ad on page 207

BOOKS/DISKS/VIDEOS

NOW THERE ARE THREE BOOKS!!
Programmers' Handbook of Computer Printer Commands

Vol. I–84: **$37.95**	Sets I & II: **$58.95**
Vol. II–85: **$26.95**	Sets I & III: **$8.95**
Vol. III–86: **$26.95**	Sets II & III: **$49.95**
	Sets I, II & III: **$77.95**

*50+ Manufact. of DWP/DMP/Color/Laser 600 Table Form
MC/VISA/CK/PO + $2 COD + $3.00 S/H

CARDINAL POINT INCORPORATED
P.O. Box 596, Dept. B, Ellettsville, IN 47429
(812) 876-7811 (M-F 9-5)

Inquiry 663.

A Print-It-Yourself Book
You may read on screen as easily as you print out the 333 pages. Educational, entertaining with a big message as far out as the doomsday scenario & the sci-fi means of survivor education. $18 for the 3 disk set for PCs, packaged with free PC-Write 2.71 complete with spelling checker.

DIA Inc.
334 Forepeak Avenue, Beachwood, NJ 08722
(201) 341-8113

Inquiry 664.

BUSINESS OPPORTUNITIES

FREE LIST
100 P.C. BUSINESSES
Personal Computer Owners can earn $1000 to $5000 monthly selling simple services performed by their computer. Work at home - in spare time. FREE list of 100 best services to offer. Write:

A.I.M.B.X
P.O. Box 60369, San Diego CA 92106-8369

Inquiry 665.

CAD/CAM

LOGIC SIMULATION
Now you can have state of the art logic simulation for only $98. Dynamic and static simulation with concurrent faults, propagation delay as a function of loading, knowledge based ATPG, interactive plotting, user friendly. (MADS Vers. 4) IBM XT/AT

MICRO-ANALYTIC
2860 Hudson Ave., Corona, CA 91719
(714) 371-5703

Inquiry 666.

COMMUNICATIONS

MULTI-USER BBS (FOR IBM PC AT)
TEAMate — a mainframe quality BBS. A mini CompuServe. Full screen cursor-controlled interface, topic outline structure, public and private topics, audit trails, xmodem, integrated mail, content retrieval and more. MS-DOS, XENIX and UNIX versions.

MMB Development Corporation
1021 No. Sepulveda Blvd., Suite K, Manhattan Beach, CA 90266
(213) 545-1455

Inquiry 667.

COMPUTER BOOKS

BORLAND
Osborne — McGraw Hill
COMPUTER BOOKS
• *ADVANCED TURBO C* 325 pgs, $22.95 • *TURBO PASCAL* Programmers Library 625 pgs, $21.95 • *USING TURBO C* 350 pgs, $19.95 • *ADVANCED TURBO PROLOG* Version 1.1 350 pgs, $21.95
Add $3.00 per book shipping, Check, Visa, MC, AX
FREE CATALOG ON COMPUTER BOOKS
MEDIA PUBLICATIONS (415) 968-3600
2166-B8 Old Middlefield Way, Mountain View CA 94043

Inquiry 668.

Computer Books Catalog!
Attn: Computer Professionals! Order *The 1987 Prentice Hall Professional/Technical/Reference Catalog: Books for Computer Scientists, Computer/Electrical Engineers and Electronic Technicians* for only $2.00 and receive $5.00 off your first book purchased from this catalog!

Prentice Hall Publishers
College Marketing Dept., Englewood Cliffs, N.J. 07632
Attn: Mary Colt **(201) 767-5937**

Inquiry 669.

COMPUTER INSURANCE

COMPUTERS + INSURANCE = SAFEWARE
Call toll free for information
• LEASED COMPUTERS • HOME COMPUTERS
• OVERSEAS COMPUTERS
• BUSINESS COMPUTERS
• COMPUTERS LEASED TO OTHERS
• COMPUTERS TAKEN TO SHOWS
• COMPUTERS HELD FOR SALE
• OTHERS' COMPUTERS IN YOUR CARE

SAFEWARE
The Insurance Agency Inc.
1-800-848-3469 IN OHIO (614) 262-0559

Inquiry 670.

CROSS ASSEMBLERS

WHY PAY MORE? THREE ASSEMBLERS FOR LESS THAN THE PRICE OF ONE
Quality cross assemblers for DOS computers. INTEL+ ABSOLUTE HEX format or BINARY format file output. Complete error checking and reporting. Data string, offsets and equates capability. Multiple origins and data definitions. Each assembler comes complete with documentation and "showfile" utility.
disk #1: 8080/8085 — 6800 — 6502
$15.95 MN residents add 6% sales tax.
ANPRI SYSTEMS
P.O. Box 26036, St. Paul, MN 55126 **(612) 347-1211**
+ INTEL is a trademark of INTEL CORPORATION
other assemblers available, call or write.

Inquiry 671.

CROSS ASSEMBLERS for
VAX VMS and **PC/MS DOS**
Faster Version 2.1 Now Available
Relocatable Macro Cross Assemblers,
Linkers, Librarians
Targeted to almost all Microprocessors
ENERTEC, INC.
BOX 1312, Lansdale, PA 19446
215-362-0966 **MC/VISA**

Inquiry 672.

CROSS ASSEMBLERS
Macros, PC Compatible, Relocatable, Conditionals, Fast, Reliable . . . . . from **$150**
also: Cross Debug/Simulators
EPROM Programmer Board
MICROCOMPUTER TOOLS CO.
Phone (800) 443-0779
In CA (415) 825-4200
912 Hastings Dr., Concord, CA 94518

Inquiry 673.

CROSS ASSEMBLERS

ASSEMBLERS & TRANSLATORS
Over 20 high quality, full function, fast relocatable and absolute macro assemblers are available immediately. Source language translators help you change microcomputers. Call for info about MS/DOS, CPM80, ISIS versions.

RELMS™
P.O. Box 6719
San Jose, California 95150
(408) 265-5411
TWX 910-379-0014

Inquiry 674.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION
More than just a straight dump or ASCII transfer!
Word Processing, DBMS, and Spreadsheet data on **Disks** or **Tapes** transferred directly into applications running on **Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters,** and **Electronic Publishing** systems.
IBM PS/2 & Macintosh supported
#1 in the translation industry!

CompuData Translators, Inc.
3325 Wilshire Blvd., Suite 1202, Los Angeles, CA 90010
(213) 462-6222

Inquiry 675.

DATA/DISK CONVERSION

Disk/Disk • Tape/Disk •OCR
Over 1,000 formats! 3½, 5¼, or 8 inch disks; 9 track mag tape; 10 MB Bernoulli cartridge. Data base and word processor translation. Specialists in Government Sensitive Data. Call for free consultation..

Computer Conversions, Inc.
We take the hassle out of data conversion . . .
9580 Black Mtn. Rd., Ste J, San Diego, CA 92126
(619) 693-1697

Inquiry 676.

DISK CONVERSIONS
Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Micom, NBI, CT, also WP, WS, MS/WRD, DW3, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.
FREE TEST CONVERSION
CONVERSION SPECIALISTS
531 Main St., Ste. 835, El Segundo, CA 90245
(213) 545-6551 **(213) 322-6319**

Inquiry 677.

DISK/DISK or TAPE/DISK CONVERSIONS — AUTOMATICALLY
Bought a new computer? Convert your data in just 1-2 days.
SAVE TIME - SAVE MONEY!
DISK/DISK or TAPE/DISK Conversions start as low as **$15.00** for IBM, CP/M, MS-DOS, UNIXV, XENIX & most other systems. (Apple, Macintosh, Commodore conversions start at $25.00). Call or write today for a cost saving quotation to fill your disk-to-disk or tape-to-disk data conversion needs.
CREATIVE DATA SERVICES
1210 W. Latimer Ave., Campbell, CA 95008
(408) 866-6080

Inquiry 678.

DISK AND TAPE CONVERSIONS
High quality conversion services & OCR scanning for Dedicated Word Processors, Mini and Micro computers. Over 1000 3½", 5¼", and 8" formats, 800-1600BPI tape. Conversion between Wang, NBI, CPT, DEC, Vydec, Lanier, OS/6, Xerox, Linolex, Lexitron, MemoryWriter, Editwriter, CompEdit, Exxon 500, Exxon Qyx, IBM Sys/34/36/38/5520, MAC, Victor, TRS, Apple II & III, NSTAR, IBM PC/AT/3½, HP, and most other Micros. Conversion directly into word processing software such as DW3, WP, MS/WRD, WS, Samna, MM, PFS, & many others.
DATA FORMATS, INC. (408) 629-1088

Inquiry 679.

THE BUYER'S MART

DATA/DISK CONVERSION

IBM PC ⇐ to ⇒ HP FILE COPY

IBM PC to HP File Copy allows IBM PCs and compatibles to read and write files written by Hewlett Packard Series 70, 80, 200, 300, 1000, 9000 computers. Call for information on this and other HP file copy programs and program translators.

Oswego Software 312/554-3567
507 North Adams St. Fax 312/554-3573
Oswego, Illinois 60543 Telex 858-757

Inquiry 680.

CONVERSION SERVICES

Convert any 9 track magnetic tape to or from over 800 formats including 3½", 5¼", 8" disk formats & word processors. Disk to disk conversions also available. Call for more info. Introducing OCR Scanning Services.

Pivar Computing Services, Inc.
165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 **(312) 459-6010**

Inquiry 681.

dBASE III COMPILERS

FREE dBASE III +
COMPILER DEMO DISK

Don't buy Clipper™ until you see our FREE dBASE Compiler Evaluation Kit. Includes DEMO DISK with 8 PRG's and results of compiling with Clipper, Quicksilver & FoxBASE +. Also 15 benchmark tests, complete magazine reviews, and detailed brochures about all 3 compilers. FREE. No obligation. Call 24 hours, 7 days.

dataBASE Specialties **(415) 652-2790**
P.O. Box 2975, Oakland, CA 94618

Inquiry 682.

DEMOS/TUTORIALS

INSTANT REPLAY II

Build Demos, Tutorials, Prototypes, Presentations, Music, Timed Keyboard Macros, and Menu Systems. Includes Screen Maker, Keystroke/Time Editor, Program Memorizer, and Animator. Recd *Great* Reviews! Simply the BEST. Not copy protected. No royalties. 60 day satisfaction money back guar. IBM and Compatb. $149.95 U.S.Chk/Cr. Crd. Demo Diskette $5.00

NOSTRADAMUS, INC.
3191 South Valley Street (ste 252)
Salt Lake City, Utah 84109 **(801) 487-9662**

Inquiry 683.

DUPLICATION SERVICES

SOFTWARE DUPLICATION

- One Stop Shopping
- Technical Support
- Custom Packaging
- Drop Shipping
- Copy Protection
- Fast Turnaround
- Competitive Pricing

SATISFACTION GUARANTEED
800-222-0490 NJ 201-462-7628
MEGA*Soft*
P.O. Box 710, Freehold, NJ 07728 *See our ad on page 318.*

Inquiry 684.

BLANKET SERVICES

Diskette duplication • Packaging • Stocking/Drop shipping • 48 hour delivery • SUPERLoK copy protection • No mastering fee • No charge for standard labels •

Star-Byte, Inc.
713 W. Main St., Lansdale, PA 19446
215-368-1200 **800-243-1515**

Inquiry 685.

ENTERTAINMENT

NFL CHALLENGE UPDATE

PROROSTR ™ increases the realism of your NFL Challenge game by providing you with an easy way to update player data files. Prints a formatted printout of the player names and data. Includes PRODATA™ the complete 1986 player roster and statistics. Requires IBM type NFL CHALLENGE (copyright XOR Corp.). PROROSTR $32 ppd. PRODATA may be purchased separately $22 ppd. Check, MO, MC, VISA

HD&S Software
Box 924183, Houston TX 77292
(713) 688-9102

Inquiry 686.

LOTTO NUMBER ANALYZER

Use your PC to help you win the Lotto. This fun-to-use program for most home computers will quickly tell you which numbers are 'due' any patterns and trends, what groups to play and more! Make your selections based on the laws of probability and INCREASE your chances of winning! ..... ***Only $24.95 + $2 s/h.***

SOFT-BYTE COMPUTER PROGRAMS
P.O. Box 556, Dayton, OH 45405
(513) 233-2200

Inquiry 687.

USE YOUR PC TO PLAY LOTTO!

Increase your chances of winning big! LOTTO-LUCK is a computer program, designed by a computer scientist using the latest techniques of Geometrical, Kabalism and Random Relationships of numbers to give you an opportunity to predict possible winning PICK/6 lotto numbers. LOTTO-LUCK will work on any lottery, in any state or country. Runs on IBM PC, C-64 and Apple II. Send $29.95 + $3 S/H to:

WIN$WARE SYSTEMS
P.O. Box 8130 H, Sacramento, CA 95818
(916) 457-5535

Inquiry 688.

FLOW CHARTS

FLOW CHARTING II+ HELPS YOU!

Precise flowcharting is fast and simple with **Flow Charting II+**. Draw, edit and print perfect charts: bold and normal fonts, 24 shapes — 95 sizes; fast entry of arrows, bypasses & connectors; Fast Insert Line; shrink screen displays 200-column chart; 40 column edit screen for detail work, much more!

PATTON & PATTON
81 Great Oaks Blvd., San Jose, CA 95119
1-800/672-3470, ext. 897 (CA residents)
1-800/538-8157, ext. 897 (Outside CA)
408/629-5044 (Outside the U.S.A.)

Inquiry 689.

STRUCTURED FLOW CHART

NSChart creates Nassi-Shneiderman (structured) flowcharts from a simple PDL. Keywords define structures & text strings appear in the chart. Easy to create, even easier to revise! Automatic chart sizing, text centering. Translators from many languages available. For Mac and IBM PC.

SILTRONIX, INC.
P.O. Box 82544, San Diego, CA 92138
1-800-637-4888

Inquiry 690.

HARDWARE

ANDY'S COMPUTERS
P.O. Box 6096, Austin, TX 78762
1 (800) 521-2283 for ordering
1 (512) 478-9803 for info

Prices include Amber Monitor (TTL), 640K M/B, 256K Installed Case, Power Supply, Keyboard, Printer, Port, Disk

Turbo XT 10 MZ.....$500 AT 286 Mini 6-12.....$964
AT 286 6-10MZ.....$958 386 16MZ.....$2775
Hard Disks Add: 20 MEG $330 Portable XT 10 MZ...$759
Portable AT.....$1190 Portable 386 16 MZ..$3200

Other equipment and configurations available at similar savings.

Inquiry 691.

HARDWARE

DISCOUNT CLONES

- XT Turbo — **$450.**
- AT 8/10 MHz — **$1200.**
- Seagate ST225 20MB hard drive with controller — **$300.**
- Seagate ST251 40MB 38ms — **$495.**
- Hayes compatible 1200 baud modem — **$99.**
- NEC multisync — **$550.**
- Panasonic KX/P 1091i — **$225.**

Automated Business Solutions
5 Broadway, 2nd Fl., Freeport, NY 11520—**516-379-3995**
30 day money back guarantee • 1 yr parts & labor warrantee
Dealer Inquiries Invited.

Inquiry 692.

INDUSTRIAL COMPUTERS
68008–68020, STD Bus I/O

OS9 PRO op sys., STD Bus and single board CPUs. SCSI, VME I/O channel, ARCNET interface to STD Bus I/O. ROM and Disk systems. Programming and hardware design services. Code conversion 680x, Z80, 8085 to 68000. Specialists in meeting industrial I/O requirements.

Bill West Inc.
174 Robert Treat Drive, Milford, CT 06460
203/878-9376

Inquiry 693.

DIGITAL SIGNAL PROCESSOR

The Model 10 for the IBM PC/XT/AT is based on the TI TMS32010 and is designed for applications in communications, instrumentation, speech, and numeric processing. A 1K complex FFT takes 90 ms. Offered with 12 bit 80 KHz A/D and D/A and continuous data acquisition & playback option. $650 and up.

DALANCO SPRY
Suite 241, 2900 Connecticut Ave, NW,
Washington DC 20008
(202) 232-7999

Inquiry 694.

CHIP CHECKER

- 74/54 TTL + CMOS
- 8000 Nat. + Signetics
- 14/4000 CMOS
- 9000 TTL
- 14-24 Pin Chips
- .3" + .6" IC widths

Tests/Identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM compatible version $259. C128 + C64 version $159.

DUNE SYSTEMS
2603 Willa Dr., St. Joseph, MI 49085
(616) 983-2352

Inquiry 695.

Save on brownout protection!

Line Conditioner keeps power constant whenever AC input power varies up or down! Prevents damage and downtime! Maintains constant output of 120V. This is a stepped transformer system that has higher efficiency than CVT's and gives lower waveform distortion. Built-in spike protection!

INDUS-TOOL
730 W. Lake St., Chicago, IL 60606
Phone 312-648-2191

Inquiry 696.

68020 COMPUTER

C Compiler and Professional OS-9/68K DOS; 68881 Math Coprocessor; 1 Megabyte non-volatile static RAM; 12.5MHz, 16.67MHz, 20MHz, or 25MHz; 20 Mb hard disk, 1 Mb floppy; 5 serial ports; parallel port; Options: Graphics; Networking; EPROM Programmer; Database; Word processing; Spreadsheet; BASIC; PASCAL; FORTRAN: Multi-CPU 8 Bit Cross Assemblers & Debuggers.

LLOYD I/O, INC.
P.O. Box 30945, Portland, OR 97230
800-227-3719 (in OR **503-666-1097**)

Inquiry 697.

THE BUYER'S MART

HARDWARE

87C51 PROG. $125.00

The UPA 87C51 Programming Adapter lets you use your general purpose programmer to program the 87C51, 8751H, AMD8753H, 87C252, and 8752BH. Also lets you program the 87C51/8751H security bits and the 87C51 encryption array. It's very simple and VERY cost effective.

LOGICAL SYSTEMS CORPORATION
6184 Teall Station, Syracuse NY 13217
(315) 478-0722 **Telex 6715617 LOGS**

Inquiry 698.

ADDCARD PUTS 8 SLOTS IN THE 5 SLOT IBM-PC FOR ONLY $79.00.

Fits inside system • 100% IBM Compatible • Uses existing motherboard • Accepts many boards including Turbo, RAM, tape backup, modem, floppy or hard disk controllers & others. • Visa/MC/COD • Call or write for orders or brochure:

1-800-231-4310 Ext. 768 / 313-562-9768
Merak Ind. • 8704 Edna • Warren MI 48093

Inquiry 699.

DOUBLE CARD

The *PERSTOR 200 Double Card* is a hard disk drive and controller already formatted that fits inside your PC, XT, AT, or compatible. And, it's easy to install—put it in your computer, turn power on, and have 40 megabytes of storage instantly! For more info call or write:

Perstor Systems, Inc.
7825 E. Redfield Rd., Scottsdale, AZ 85260
(602) 991-5451

Inquiry 700.

16 BIT DEVELOPMENT SYSTEMS

The URDA 68000 or 8086 computer-in-a-notebook series includes a 68000 or 8086 16 bit processor with keyboard, display, tape and interface I/O, power supply, Documentation, Schematic, Operating System (accessories available). List Price—**$295.00**

Educational Discounts Available.

Phone Quasitronics, Inc.
at 1-800-245-4192, in PA, 412-745-2663.

Inquiry 701.

PC WHOLESALE CENTER

Hyundai TTL Amber Monitor	$ 72.00
Hyundai TTL Green Monitor	$ 70.00
AT Compatible Bare Bone System (10 MHZ Motherboard, Case, 200W Power Supply)	$460.00
XT Compatible Bare Bone System (8 MHZ Motherboard, Case, 150W Power Supply)	$160.00

MGP Card—$ 46.00 Multi I/O—$ 56.00

SANFORD SYSTEM INC.
10413 Rockley Rd., Houston, TX 77099
(713) 879-0068

Inquiry 702.

NEW/USED APPLES & STUFF

MACINTOSH $800.+ up
Apple IIGS & IIE — Call
Mac accessories—hard drives Call
We buy, sell & horsetrade — Apple, IBM.

SHREVE SYSTEMS
845 Lark Ave., Shreveport, LA 71105
318-865-6743 4–9 p.m. • 1-800-227-3971
C.S.T.—VISA/MC

Inquiry 703.

HARDWARE

USA WHOLESALE

1200/2400	EVEREX MODEM	$89/$189
EMS/EGA	EVEREX CARDS	$99/$159
SERIAL/BUSS	LOGITECH MOUSE	$72/$89
20MB/30MB	HARD DRIVE KIT	$299/$359
3.2/6MHZ/8MHZ	DOS/8087	$75/$99/$139
6/8/10/MHZ	80287	$159/$239/$289

214-418-0017
P.O. Box 819058-590, Dallas, Texas 75381

Inquiry 704.

HARDWARE/ADD-ONS

APPLE COMPATIBLE 1 MEG RAM BOARDS!
One Year Warranty! Other Products Available!

1 Meg/80 Col Board, w/256K & SFWR (IIe).....**$99.**
1 Meg RAM Board for IIGS w/256K.....**$89.**
Cooling Fans.....(IIGS **$25**) (II+/IIe **$29**)
A/B Switchbox Parallel or RS-232.....**$29.**
Add **$3** Shipping. COD + $2. MC/VISA OK.
UNIVERSITY & SCHOOL P.O.'s WELCOME!

NEXO DISTRIBUTION(619) 589-7928
914 East 8th St., Ste. 109, National City, CA 92050
Monday – Friday, 10 a.m. – 6 p.m.

Inquiry 705.

Z80™ / HD64180/CP/M™ CO-PROCESSORS
Plug-in co-processors for PC, PC/AT.
Blue Thunder Z80 co-processors
6 MHz **$249.95** 10 MHz **$399.95**
12.5 MHz **$599.95**
HD64180 co-processors **$295** and up
All co-processors with CP/M emulator. Software only emulator **ZSIM** only $99.95.

Z-WORLD **916-753-3722**
1772A Picasso Ave., Davis, CA 95616
See Ad Page 304.

Inquiry 706.

HARDWARE/COPROCESSOR

PC MINI-SUPERCOMPUTER
Up to 36 MIPS In Your PC!

Fill your PC/XT/AT with 1 to 6 PC4000 boards for a high speed PC-RISC system. The PC4000 uses the NC4016 RISC Engine which executes high level Forth in silicon. Each PC4000 is a general purpose parallel coprocessor that delivers speeds in the 5 to 7 MIPS range . . . over a 100 times faster than a PC, K & R standard C and Forth available. From $1295.

SILICON COMPOSERS (415) 322-8763
210 California Ave., Suite I, Palo Alto, CA 94306

Inquiry 707.

HARDWARE/PERIPHERALS

GM CAR COMPUTER READ-out

- Read engine computer data
  Is sensor data reasonable?
  Are status switches set?
  Are any trouble codes set?
- Make disk records of car packets
- Let your PC be automotive.

EXECUTIVE ELECTRONICS, INC.
938 Main St., Dept. B., Yarmouthport, MA 02675
(617) 362-3694

Inquiry 708.

HRDWRE/POWER PROTECT.

POWERLINE GREMLINS?? POWER FAILURES??

The MEIRICK STANDBY POWER SYSTEM is the TOTAL SOLUTION to your powerline problems.
400 watt system - **$449;**
800 watt system - **$795**

MEIRICK Inc., POWER SYSTEMS DIV.
Box 298, Frisco, CO 80443 **303-668-3251**
1-800-323-5911

Inquiry 709.

HARDWARE/UPS

SOLA MINI UPS
Surplus Sale

NEW, 750 VA Deluxe, high in-rush, uninterruptible power supply. Sola model 26-00-50750-3800, 50 or 60 Hz.

LIST PRICE: $2,500.....**Our Price: $875**

IME **International Materials Exchange**
33 Agassiz St.
Cambridge, MA 02140 **617-497-2290**

Inquiry 710.

INVESTMENT

CAPTOOL! ™ **$59**

Multiple portfolio manager. Stocks, bonds, funds, dpr. assets. True ROI before/after taxes. DJ/Compuserve pricing. Batch & client features. Stock & bond evaluators. Beats all others! IBM PC or PS/2. $3 S&H. Chk/VISA/MC.

TECHSERVE, inc.
P.O. Box 70056, Bellevue, WA 98007
800-826-8082 or 206-747-5598

Inquiry 711.

LAPTOP COMPUTERS

LAP-LINK

The ultimate solution for linking laptop computer with any IBM compatible desktop PC. 115, 200 baud transfer rate—faster than any other product available. No installation necessary, easy to use split screen design. Includes incredible "universal cable" that connects any two computers. Transfer entire disks faster than a DOS copy command! Only **$129.95** including universal cable and both 3½" and 5¼" disks. "Bridge" owners can trade in for only **$89.95** w/o cable.

Traveling Software, Inc.
19310 North Creek Parkway, Bothell WA 98011
1-800-343-8080 **(206) 483-8088**

Inquiry 712.

MAILING LIST PROGRAMS

Professional List Management

ArcList — mainframe mailing list management for the XT/AT/386. Capacity 20 million names, automatic zip and state verification, print any label, custom charts and reports, merge-purge with excellent near-dupe recognition, match codes, postal presorting of all classes of mail, Nth sampling, much more. **$595.** Save thousands of dollars. Call for free 16 page booklet.

Arc Tangent, Inc.
923 Olive St., POB 2009, Santa Barbara, CA 93120
800-843-5928 (in CA. **805-965-7277**)

Inquiry 713.

MUSIC

Electronic Musician

The leading magazine on using computers for music, **EM** features articles on MIDI, music software, electronic instruments and home recording.

"the BYTE of the electronic music world"
—Jerry Pournelle, BYTE, 12/86.

Special offer: only $11 US ($21 US foreign) brings you a full year (12 issues)!
800-334-8152; 619-745-0687 in CA

Electronic Musician
Dept. B, 2608 Ninth St., Berkeley, CA 94710

Inquiry 714.

NETWORKING

Multiple Users Under PC DOS

PC-MOS/386 and Multilink Advanced turn DOS into a powerful multiuser O/S. Connect inexpensive CRT terminals to serial ports on XT/AT/386.

- Complete line multiuser hardware/software
- Custom system configurations available.

Call Today for Free Consultation

201-222-6363
DATATRUST
379 Westwood Ave., Long Branch, NJ 07740

Inquiry 715.

THE BUYER'S MART

PROGRAMMER'S TOOLS

Modula-2

REPERTOIRE is an integrated DBMS, window/forms/menu generator, multi-window text editor, and expression evaluator designed specifically for M2. Only $89 with full (600K) source code and 320p printed manual. Complete manual for this and many other M2 tools available on free demo disk. MC/VISA/AMEX/PO/COD.

PMI 4536 SE 50th, Portland, OR 97206
(503) 777-8844; BIX: pmi

Inquiry 716.

FREE PRICE GUIDE

Call or write for our FREE comprehensive price guide containing hundreds of languages, utilities and books specifically for IBM personal computers and compatibles. We're the world's leading independent dealer of programmer's development tools because we provide sound advice, low discount prices, fast delivery, FREE U.S.A. shipping and no hidden charges.

Programmer's Connection **800-336-1166 USA**
216-877-3781 OH & AK (Collect) **216-877-3781 OH & AK (Int'l)**
136 Sunnyside St. **800-225-1166 Canada**
Hartville, OH 44632 **9102406879 Telex**

Inquiry 717.

PUBLIC DOMAIN

$3 SOFTWARE FOR IBM PC

Public Domain & User Supported Software. Hundreds to choose from, wordprocessors, data bases, spreadsheets, assorted games for all ages, communications, business, music, art, programming language and useful utilitites for making your computer easier to learn. Most programs have documentation on the disk. Write for your FREE catalog today!

BEST BITS & BYTES
P.O. Box 5332, Dept-B, North Hollywood, CA 91616
(818) 893-6304

Inquiry 718.

PUBLIC DOMAIN SOFTWARE

Over 3000 disks covering PC/MS-Dos, CP/M, MacIntosh, Atari and Amiga. Priced from $6/disk by mail or download by modem from our 19 remote systems. (300–9600 baud. 600+ Megabytes online) for flat annual charge of $50 (US). Fast service, shipped around the world. Call or circle inquiry #720 for our FREE 40 page minicatalog of highlights.

CANADA REMOTE SYSTEMS LIMITED
(1-416-231-2383)

Inquiry 719.

RENT SOFTWARE $1/DISK

Rent Public Domain and User Supported Software for $1 per diskfull or we'll copy. IBM, Apple, C-64, Sanyo 550 and Mac. Sampler $5. VISA/MC. 24 hr. info/order line. (619) 941-3244 or send #10 SASE (specify computer) Money Back Guarantee!

FutureSystems
Box 3040 (T), Vista, CA 92083
office: 10-6 PST Mon.-Sat. **(619) 941-9761**

Inquiry 720.

★ ★ FREE Catalog ★ ★

Collection of over 1700 programs collected on 180 diskettes, each diskette costs $3.75. Wide variety of programming, including:

- Games
- Word Processing
- Personal Finance
- Lotus Clones
- CAD Systems
- Database Systems

And Much More!!!

Call 1-800-843-5084
People's Choice Software
P.O. Box 3061, Warner Robins, GA 31099

Inquiry 721.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- General Ledger
- Accounts Recvbl.
- Order Entry
- Sales Analysis
- Purch Ord/Invntory
- Accounts Payable
- Job Costing
- Job Estimating

$99 EA. + s&h w/dBASE 2, 3 or 3+ SOURCE CODE

dATAMAR SYSTEMS Cr. Crd/Chk/COD
4876-B Santa Monica Ave.
San Diego, CA 92107 **(619) 223-3344**

Inquiry 722.

SOFTWARE/A.I.

NEW INTEGRATED ENVIRONMENT AI FOR THE IBM PC

TOPS! IS A FULL VERSION OF **OPS5** WHICH RUNS UNDER MS-DOS, UNIX OR CP/M. A FAST, EFFICIENT EXPERT SYSTEM DEVELOPMENT TOOL.
PROTOTYPING: **$125** PRODUCTION: **$250**
PROFESSIONAL: **$375** SHIPPING, ADD **$5**

DYNAMIC MASTER SYSTEMS
POB 566456, Atlanta, GA 30356
(404) 565-0771 **Telex #282923**

Inquiry 723.

SOFTWARE/BASIC

CUT CODE & HASSLE 80%

EPI-tools (top level library & utilities) for QuickBASIC. Maximum ease, minimum code, top performance! Use EPI-tools and get your own way!

Call E.P.I. (dpt. B1) for **FREE DETAILS** or $4 DEMO DISK $69 Introd. offer—Money back guarantee—Visa/MC/AmEx-MO

European Personal Informatics
13607 Runney Meade Dr., Sugar Land, TX 77478
(713) 242-6371
EPI/BELGIUM:
Rue de l'Echelle, 253-B,4100 SERAING — Telex 42037

Inquiry 724.

COMPILED BASIC TOOLS

We now carry a complete line of libraries and tools for Compiled BASIC in addition to our FINALLY! series. Get our catalog of top brand products for Compiled BASIC, by calling 1-800 423-3400 (9:00 AM to 8:00 PM EST)

KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215
PA & AK call (412) 782-0384

Inquiry 725.

SOFTWARE/BUSINESS

DATA ENTRY SYSTEM

Heads-down data entry with two-pass verification for the PC/XT/AT & compatibles. Loaded with features like: Auto dup & skip, verify bypass, range checks, & table lookups. Fully menu driven only $395.
Call for free 30 day trial period.

COMPUTER KEYES
21929 Makah Rd., Woodway, WA 98020
(206) 776-6443

Inquiry 726.

LP88 — SPREADSHEET LP

Our best-selling menu-driven linear programming system now solves problems with 1000 constraints and 5000 variables up to 30 times faster. New version reads/writes Lotus worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Many other features including interactive and batch operation, spreadsheet-style display, equation processor, problem/basis storage, file I/O. Simplex restart, report generator, sensitivity analysis. *IENews* says: "The flexibility and features of this program are a bargain at its low price." $149 with 8087 support and 100-page manual. $29 for working demo and mini-manual.

EASTERN SOFTWARE PRODUCTS, INC.
P.O. Box 15328, Alexandria, VA 22309
(703) 360-7600

Inquiry 727.

SOFTWARE/BUSINESS

dFELLER Inventory

Business inventory programs written in modifiable dBASE source code.
dFELLER Inventory **$150.00**
Requires dBASE II or III, PC-DOS/CPM
dFELLER Plus **$200.00**
with **History** and **Purchase Orders**
Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 728.

SOFTWARE/CHURCH

PowerChurch Plus®

Fast, friendly, reliable church administration system. Full fund accounting, mailing lists, membership, contributions, attendance, word processing, accts. payable, payroll, multi-user support, and much more - all for $495 complete. FREE demo version.

F1 SOFTWARE
P.O. Box 3096, Beverly Hills, CA 90212
(213) 854-0865

Inquiry 729.

Church Package

Parishioner Time, Talent and Treasure System program is written in modifiable dBASE source code.

- Contributions • Disbursements • Ledger
- Names with mailing labels
- Personal information database.

Requires dBASE II or III. PC-DOS/CPM-80 $200.

Feller Associates
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 730.

ROMAR CHURCH SYSTEMS™

Membership-61 fields plus alternate addresses; labels, letters, reports any field(s). Offering-256 funds; optional pledge; statements; post to 255x/yr. Finance-gen. ledger w/budget; up to 500 subtotals & 99 depts., month & YTD reports anytime for any month. Attendance—8 service times, 250 events per service; 60 consecutive weeks. Available for floppy, 3½ & hard disk. Ad too short! Write for free 48-page guide.

Romar Church Systems, Attn: BJB
P.O. Box 4211, Elkhart, IN 46514
(219) 262-2188

Inquiry 731.

SOFTWARE/COMMUNICATION

SPECIAL BBS OFFER FOR IBM

IDEA-TREE Multi-topic system. Public/private msg. areas, file transfer, Xmodem, database, more ***$99***
PC-DATE Matchmaking system. Modifiable questionnaire, public/private msgs., pref. screening ***$79***
BAUDCAST Message distributor for announcements, news or any text to remote receiving stations ***$59***

ProtoSoft
P.O. Box 16756, Seattle, WA 98116
(206) 932-5310 (voice) or **(206) 932-7125** (BBS)
VISA/MC

Inquiry 732.

SOFTWARE/DIGITIZERS

Affordable Digitizing Software — $250

DIGITIZE determines the global coordinates for points, lines, polygons, & automatically computes length, areas & volumes. Plots the data on screen while digitized. Remembers the coordinate system calibration when computer is off. Writes to stand. ASCII files. Currently supports numonics, Kurta, & Summagraphics. Call for free catalog of scientific software.

ROCKWARE, INC.
7195 W. 30th Ave., Denver, CO 80215 USA
(303) 238-9113

Inquiry 733.

THE BUYER'S MART

SOFTWARE/EDUCATION

THE GMAT COURSE (PC/XT/AT)
Covers every type of exam question with instant feedback, solutions, timed tests, personalized score analyses, math and grammar reviews. All material is on the screen. Designed by MBA's, the program has improved students' scores by as much as 250 pts. Includes 5 disks + manual. **$59.95**

COMWELL SYSTEMS, INC.
P.O. Box 41852, Phoenix, AZ 85080
(info & orders) **(602) 869-0412**
(orders only) **(800) 255-2789**

Inquiry 734.

SOFTWARE/ENGINEERING

Affordable Engineering Software
CALL OR WRITE FOR FREE CATALOG
Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Graphics • Signal Processing • Filter Design • Report Proofreader • Transfer Function Analysis • PC/MSDOS • Macintosh • CP/M. VISA/MC.

BV Engineering • *(714) 781-0252*
2200 Business Way Suite 207, Riverside, CA 92501

Inquiry 735.

Scientific Plotting Pkg.
Engineers/scientists prepare publication quality plots with F-CURVE. A few of F-CURVE's features: Plot-data, smooth curve through data, regression curves (linear or nonlinear). Draw linear, log, inverse, or power axis. Label plot. You have total control. For MS-DOS and HP Plotters.
$59.95 /VISA/MC/check

LEDS Publishing Co., Inc.
P.O. Box 12847, Research Triangle Park, NC 27709
(919) 477-3690

Inquiry 736.

Engineering/Scientific Journal
ACCESS is the only journal devoted to meeting the needs of engineers/scientists using microcomputers. If you are interested in numerical analysis, statistics, modeling, expert systems, or other technical applications, subscribe to ACCESS. **$21/yr.** VISA/MC/check.

LEDS Publishing Co., Inc.
P.O. Box 12847, Research Triangle Park, NC 27709
(919) 477-3690

Inquiry 737.

SIMULATION WITH GPSS/PC™
GPSS/PC™ is an IBM personal computer implementation of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your simulations. Simulate complex real-world systems with the most interactive and visual yet economical simulation software.

MINUTEMAN Software
P.O. Box 171/Y, Stow, Massachusetts, U.S.A.
(617) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 738.

ENGINEERING SOFTWARE
You will save hours of development time with our library of integrated programs.
- Graph Plotting
- Equation Processing
- Simultaneous Equations
- Complex Arithmetic
- Pop Up Calculator
- Fourier Transforms
- Top Down Designer
- and more...

For a FREE CATALOG: write

Pulse Research
Dept Eng 5, P.O. Box 696, Shelburne, VT 05482
(802) 985-2928

Inquiry 739.

SOFTWARE/GENERAL

3 VANISHING POINTS
- 3-D Perspective Processor: Moving realistic view with complicated rotation capability. **$99.95** + $4.00 S&H.
- Secured Communication System: Conceal information from any level of unauthorized access; indecipherability is assured by advanced Number Theory. **$349.95** + $4.00 S&H.
- Both require IBM PC or compatible (256K up).

bp-Coding Systems
2445 University Heights Ave., Boulder, CO 80302
telephone (303) 442-1943 • facsimile (303) 442-1967

Inquiry 740.

WOULD YOU LIKE TO KNOW?
Your I.Q.? Memory Level? Response Time? Coordination? Visual Perception?
Expand your mind with **MENTOR™**—software that lets you explore your hidden talents. 58 psychometric exercises, incl. 25 I.Q. tests.
IBM PC/Compatibles • 256K • $49.95 • VISA/MC

Heuristic Research, Inc.
3112-A West Cuthbert Ave., Midland, TX 79701
***800-443-7380** (In TX, collect **915-694-5936**)*

Inquiry 741.

SAVE 90% ON SOFTWARE!
Shareware programs compare favorably to commercial programs costing $200 and up! EZ Forms, PC Key Draw, PC Outline, PC Accounting, over 170 others to choose from all for $6.95 or less per disk! Money-back guarantee. IBM PC, Jr, or compatibles. Send today for FREE catalog.

SHAREWARE EXPRESS
31877 Del Obispo, Suite 102M, San Juan Capistrano, CA 92675

Inquiry 742.

MUSIC LIBRARY DATABASE PROGRAM.
Catalogue your records, tapes, CD's, scores. Store 30,000 compositions on hard disk; search by Composer, Title, Music Category, Opus, and combinations of above; find any composition in one second. Find any Performer. Index files—no sorting; many reports. IBM PC and compatibles, 192K, one floppy. Just $19.95 plus $2.00 shipping. 60-day money-back.

The Software Guild, Inc.
P.O. Box 654335, Dept. B, Miami, FL 33265-4335

SOFTWARE/GRAPHICS

GRAPHICS PRINTER SUPPORT
AT LAST! Use the PrtSc key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer. GRAFPLUS supports all versions of PC or MS-DOS with IBM (incl. EGA), Tecmar, and Hercules graphics boards. $49.95.

Jewell Technologies, Inc.
4740 44th Ave. SW, Seattle, WA 98116
800-628-2828 x 527 (206) 937-1081

Inquiry 743.

FORTRAN PROGRAMMER?
Now you can call 2-D and 3-D graphics routines within your FORTRAN program.
GRAFMATIC: 75 callable routines for screen output. **$135.**
PLOTMATIC: Pen plotter driver. **$135.**
For the IBM PC, XT, AT and compatibles. We support a variety of compilers, graphics boards and plotters.

MICROCOMPATIBLES
301 Prelude Drive, Dept. B
Silver Spring, MD 20901
(301) 593-0683

Inquiry 744.

SOFTWARE/GRAPHICS

GRAPHICS/PICTURE DISKS
** Fabulous ** new graphics for PRINT SHOP, PRINT MASTER, NEWSROOM, NEWSMASTER, MACPAINT, PC PAINT, WINDOWS, VENTURA, and PERSONAL PUBLISHER. Available in IBM, Apple, C64 and Kaypro CP/M formats. Catalog and demo disk $9.95 + $2.50 S/H.
Specify one pgm and one disk format.

Steele Publishing
Dept. B1, P.O. Box 5493, Concord, CA 94524
(415) 685-7265

Inquiry 745.

CGA→Hercules™ Graphics
Mode-MGA™ allows you to use business graphics, games, BASICA graphics and other CGA specific software with your Hercules™ Monochrome Graphics adaptor and monochrome monitor. Works with all CGA programs. **$79.95** (+ $5 s&h) for the 3k-TSR version. 30-day money back guarantee. Call or write:

T.B.S.P. Inc.
2265 Westwood Blvd., Suite 793, Los Angeles, CA 90064
(213) 312-0154

Inquiry 746.

SOFTWARE/HOME/BUSINESS

AUTO-PILOT
If your home/office requires you to remember countless assignments/tasks, put these responsibilities on AUTO-PILOT. Ideal for small businss & busy homeowners. Easy to use. Reminds you of repeating/one-time events. PC/XT/AT/comp $29.95 Check/Visa/MC.

Advanced Concepts
P.O. Box 246, Ironia, N.J. 07845
1-800-628-2828 x 655

Inquiry 747.

SOFTWARE/LANGUAGES

NS32000 MODULA-2 COMPILER
Fast Program Development System for use with MODULA-2 application programs enables you to write entire ROM-based NS32000 target programs in MODULA-2. INLINE code procedure as well as data-types LONGINT, REAL, LONGREAL supported. Complete w/"System" module (runtime support) in source form. Requires IBM-PC or Compatible with free ½ card slot. No debugger or programmer included as yet. U.S. $1995

ALOIS SCHÖNBÄCHLER
Freischützgasse 14, CH-8004 Zürich, Switzerland
41-1-241-0514

Inquiry 748.

Minnesota **SNOBOL4.2** *Language*
Powerful string & data handling facilities. Improved speed, I/O & functions. Interpreter compatible with mainframe SNOBOL4. 64K strings, 32 bit integers, 8087 for float & large memory model. Sample pgms include ELIZA. For >256K IBM PC & DOS > 2.0. Definitive "green" book by Griswold et al recommended.
Programmer's Guide +5¼" SSDD diskette..... **$59.95**
"Green" book. ISBN 0-13-815373-6..... **$28.95**
Postpaid in USA. In NY add tax. VISA/MC **(914) 271-5855**

BERSTIS INTERNATIONAL
P.O. Box 441, Millwood, NY 10546

Inquiry 749.

THE PL/M CONNECTION
- Your link to the IBM PC from PL/M 86
  Write programs—Create utilities
  Build application systems
- Complete system interface libraries
- Dos 1, Dos 2, Dos 3, Bios, Graphics
- Large and compact memory modules
- 200 page Technical Reference Manual
- Complete source in PL/M 86 and Assembler
- Demonstration utilities with source

CompuFirm Corporation
7841 Balboa Ave., Ste 210, San Diego, CA 92117
(619) 571-0228

Inquiry 750.

THE BUYER'S MART

SOFTWARE/LANGUAGES

DRUMA FORTH-83
Developed for in house use. No 64K limitation. 64K speed & compactness. Strict **'83 STANDARD.**
- Rom code, headerless code, separated variables
- Assembler, DOS interfaces
- Editor, examples, on disk documentation
- IBM PC/XT/AT, Clones, DOS 2.0+
- Full Pkg. **$79.** Demo **$10.** S&H **$2.**

DRUMA FORTH-83, DRUMA INC.
P.O. Box 610097, Austin, TX 78761 **512-323-0403**

Inquiry 751.

MACINTOSH DEVELOPERS
Speed up application development and PC to MAC porting with compiled libraries. • **PROGRAMMER'S EXTENDER VOL. 1** — menus, windows, dialogs, text edit — **VOL. 2** — Printing, graphics, lists. • **Extender GrafPak-line, bar, log, graphs; multiple curves; customizable.**

Invention Software Corp.
P.O. Box 3168, Ann Arbor, MI 48106
(313) 996-8108

Inquiry 752.

SCRUTINY
- An advanced symbolic debugger for all MS-DOS computers
- Compatible with Turbo Pascal, Microsoft Assembler, others
- Packed with features, including support for graphics and 80386 debug registers

M STREET SOFTWARE
5400 E. Mockingbird Lane, Suite 114, Dallas, TX 75206
214-827-4908
Information also available via our 24 hr. 300/1200 modem: 214-669-1882

Inquiry 753.

FORTRAN Power Tools™
Tools to help you dissect, debug, and document programs and more. Indispensable for large programs and programs written by others. These tools can generate detailed x-ref maps, produce tree diagrams of global routine calls and lists of routines appear in the programs, print text and output files, extract routines, combine files, do string search, etc. IBM PC with DOS 2.0+.
Introductory price **$119.95 + $3.50 S&H** VISA/MC/MO/Check

PJN International
P.O. Box 200423, Austin, TX 78720
(512) 258-1235

Inquiry 754.

Turbo.ASM
The only package designed to I/F **Turbo Pascal** and MASM.
Make MASM calls without affecting code space. Pass data back and forth. Learn internals of Turbo Pascal. Use Turbo Pascal to learn MASM! Includes source & more!

PM Tools (415) 366-2062
748 Holly Hill, Redwood City, Ca. 94061 $45.00

Inquiry 755.

SOFTWARE/MUSIC

SongWright III
Music Processor for IBM Compatibles
Prints quality lead sheets, songs, scores with text and symbols, multiple staves; transposes to any key; plays tunes. Screen graphics editor; IBM/Epson/Star printers. Send **$49.95,** $2 s&h or write for free sample output.

SongWright Software
Route 1, Box 83, Lovettsville, VA 22080
(703) 822-9068

Inquiry 756.

SOFTWARE/REAL ESTATE

MANAGEMENT & ANALYSIS
REAL PROPERTY MANAGEMENT II . . . . $395/$595 for apts., shopping centers. . . Records and budgets income/expense by month/account/unit. Writes checks, invoices, 1099 forms, allocates costs. P&L and cash flow by property and owner.
REAL ANALYZER. . . . . $195 for detailed analysis of residential & commercial properties. Easy "WHAT IF?" 30-day money-back guarantee.

REAL-COMP, INC.
P.O. BOX 1263, CUPERTINO, CA 95015
408-996-1160

Inquiry 757.

SOFTWARE/SCIENTIFIC

Data Acquisition & Analysis on PC's
- ★ FOURIER PERSPECTIVE II Advanced Digital Signal Analysis.
- ★ PRIME FACTOR FFT subroutine library. Call from Turbo Pascal, C, Fortran, Basic. Up to 65,520 data points. 2D interface available. Rectangular FFT's now possible in a multitude of dimensions.
- ★ 2 & 3D Scientific Graphic packages with plotter support from Golden Software.
- ★ Data Acquisition & Control Boards from MetraByte, Analog Devices, Burr-Brown, Strawberry Tree, National Instruments, Contec, & Tecmar.
- ★ Data Acquisition & Analysis Software—Labtech Notebook, Asyst, UnkelScope, Lotus Measure with 1-2-3/Symphony, & Quinn-Curtis.

Call for FREE Application Assistance & Technical Literature
LOW PRICES—Satisfaction GUARANTEED

Alligator Technologies — (714) 722-1842
P.O. Box 11386 Costa Mesa, CA 92627

Inquiry 758.

Do You Need to do This on Your PC?

$$614\ 1/8\ \text{cu in} \;/\; 1.2\ \text{liter per sec} = 8.386421\ \text{sec}$$

Lascaux1000, *"The Intelligent Calculator".* (For IBM PC's) Verify logic of calculations. Reduce steps by 50%. Extensive table of physical constants. Easily customized. Much more! **$59.00** Demo disk $1.

Lascaux Graphics 3220 Steuben Ave.
Bronx, NY 10467 (212) 654-7429

Inquiry 759.

SCI-GRAF and **SCI-CALC**
SCI-GRAF produces huge hi-res graphs thru easy menus or linkable C libraries. Supports log scales, error bars, screen and printer output.

SCI-CALC is a pop-up calculator with complete expression editing, scientific, statistical, and logic functions.

Prices start at $79.95.

Microcomputer Systems Consultants
Box 747, Santa Barbara, CA 93102
(805) 963-3412

Inquiry 760.

ORDINARY/PARTIAL DIFFERENTIAL EQN SOLVER
FOR THE IBM PC & COMPATIBLES

MICROCOMPATIBLES INC.
301 Prelude Dr., Silver Spring, MD 20901
(301) 593-0683

Inquiry 761.

FitAll
NONLINEAR REGRESSION ANALYSIS
★ *TurboPascal v3* ***source*** *for PC/XT/AT with CGA*
★ *Menu of 20 user-definable functions (models)*
★ *Multiple independent variables* ★ *Weighting*
★ *2D plots* ★ *Manual on disk*
★ ***$45US ($60Can)*** *+ $5US outside USA & Canada*

MTR Software
P.O. Box 13, Islington A, TORONTO, Ontario M9A 4X1 Canada

Inquiry 762.

SOFTWARE/SCIENTIFIC

forMath® text-formatter
- Equations, matrices, ratios, integrals, diagrams
- Macros, fonts, Greek/math symbols
- Hyphenation, secn/eqn/ref numbering
- Indexes, table of contents, footnotes
- Dot-matrix, daisywheel, laser printers, all monitors

$400. $50 for demo

SHANTHA SOFTWARE INC.
50 West 97th St. Room 11N, New York City 10025
(212) 222-SNIP
Touchtone toll free: **950-1088-wait-FORMATH**

Inquiry 763.

Linear Programming
MATRIX CALCULATOR reads/writes LOTUS WKS files, performs linear programming, linear regression, solve system of equations, eigenanalysis, and other matrix operations. Requires 8087. $60 includes free software.
$120 w/Turbo Pascal source code plus more.

SoftTech Inc.
14640 LaBelle, Oak Park, MI 48237
1-313-544-8544

Inquiry 764.

SOFTWARE/SORT

OPT-TECH SORT/MERGE
Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and filetypes including Btrieve and dBASE. Unlimited filesizes, multiple keys and much more! MS-DOS **$149.** XENIX **$249.**

(702) 588-3737

Opt-Tech Data Processing
P.O. Box 678 - Zephyr Cove, NV 89448

Inquiry 765.

SOFTWARE/TAX PREP.

TaxEase™ System
Federal & State returns on single disk—only $69.95. Easy to use. Calculates automatically, performs complex "What if" options, prints IRS-approved forms. AZ, CA, CO, DC, GA, IL, IN, MA, MD, MI, MN, MO, NC, NJ, NY, OH, OK, PA, VA, WI. Requires Lotus 1-2-3 or comp. spreadsheet. VISA/MC. $3 s/h chg. Money back guarantee. Professional package available—**$99.**

Park Technologies, Inc.
P.O. Box 1317, Clifton Park, NY 12065
518/877-5881 or 800/423-3189 outside NY

Inquiry 766.

SOFTWARE/TOOLS

The BASASM library
a powerful set of routines for the Basic programmer to create disk utilities: Read/Write sectors, Edit sectors/Dir/Partitions, GetInfo + many others to scroll video and sort data. For IBM PC/XT/AT.
US$ 45 + 10 sh./handl.

CEDIT sas.
Via Leopardi 32-50054 Fucecchio (Fi) Italy
Tel. (0571) 260224

Inquiry 767.

SCREEN MANAGER
MENU, WINDOW, and DATA ENTRY Support for the Professional Programmer! Interfaces to most languages. BASIC, C, FORTRAN, COBOL, PASCAL, ASSEMBLER. 100 Page Manual. Thirty day money back guarantee. No Royalties.
from $79. Visa/MC

The West Chester Group
P.O. Box 1304, West Chester, PA 19380
(215) 644-4206
CALL FOR FREE DEMO

Inquiry 768.

THE BUYER'S MART

STATIONERY

Custom PC Stationery

Continuous printed letterheads w/micro perf edges. Matching window or regular envelopes. Numerous colors, inks & papers at lowest prices. Fast delivery & top quality. We'll print your present design or set type for your new design.

Call toll free 800-624-2961 (TN: 901-756-7010) for free samples & price info., or write:

PerFORMS Press
8456 Lofton Cove, Cordova, TN 38018

Inquiry 769.

STATISTICS

STATISTICS CATALOG!

If you need statistics for IBM PC or Apple II, call us and let our technical advisors help you find the statistics programs you need.
Write or call now to get a FREE catalog of statistics and quality control software.

HUMAN SYSTEMS DYNAMICS
9010 Reseda Blvd., Ste. 222
Northridge, CA 91324
(800) 451-3030 (818) 993-8536 (CA)

Inquiry 770.

NUMBER CRUNCHER STAT SYS

Menu-driven. Multiple & stepwise regression, ANOVA, time series, discriminant cluster and factor analysis, principal components, scatter plots, histograms, t-tests, contingency tables, nonparametrics. Import export data. Spreadsheet, sort, join, merge. $99. MS-DOS. Quantity discount.

NCSS-B
865 East 400 North, Kaysville, UT 84037
801-546-0445

Inquiry 771.

STATISTIX™ II

Comprehensive, powerful and incredibly easy-to-use. Full screen editor, transformations, linear models (ANOVA, regression, logit, PCA, etc), ARIMA, most standard stat procedures. Clear, well organized documentation. Satisfaction guaranteed. $169 PC DOS, $99 Apple II.

NH ANALYTICAL SOFTWARE
P.O. Box 13204, Roseville, MN 55113
(612) 631-2852

Inquiry 772.

RATS! Version 2.1

Best selling econometrics program. Over 4000 copies sold. OLS, 2SLS, logit, probit and much more! Forecasting with ARIMA, VAR. Exponential smoothing. Model simulations. Support for daily/weekly data. High-quality graphics to screen, plotter, printer. $200–$300. VISA/MC. Demo available.

VAR Econometrics, Inc.
P.O. Box 1818, Evanston, IL 60204-1818
(312) 864-8772; (800) 822-8038

Inquiry 773.

StatPac Gold™

StatPac Gold is the high-powered statistics and forecasting package that delivers! It's fast, flexible, easy to use and dependable. Time-tested and loaded with features. It's all here! Unlike any other. Get the facts! Call now for your FREE brochure.

1-800-328-4907
Walonick Associates, Inc.
6500 Nicollet Ave. S., Minneapolis., MN 55423
(612) 866-9022

Inquiry 774.

STATISTICS

Spreadsheet Statistics

NEW! 23 comprehensive statistics and forecasting modules for analyzing LOTUS worksheets. Low cost $24.95 each. Easy to use. Includes tutorial. Basic and advanced statistics with graphics and many user-definable options. Compare. Free brochure.

Walonick Associates, Inc.
6500 Nicollet Ave. S., Minneapolis., MN 55423
(612) 866-9022

Inquiry 775.

UTILITIES

SOURCE CODE LIBRARIAN & VERSION CONTROL SYSTEM

TLIB™ keeps ALL versions of your program in ONE compact library file, even with hundreds of revisions.
• 5 times faster than SCCS • LAN compatible
• Free public domain **MAKE** (with source) by L. Dyer
MS/PC-DOS 2.x & 3.x. $99.95 + $3 S&H. VISA/MC

BURTON SYSTEMS SOFTWARE
POB 4156, Cary, NC 27511
(919) 469-3068

Inquiry 776.

ASSEMBLY LANGUAGE PRE-PROCESSOR

Add high level features to any assembler for any micro. Supports *"begin," "while," "repeat," "until," "if," "switch,"* and other constructs as efficiently as hand-coded assembler. Checks program integrity and eliminates bugs. Create manuals with tables of content from comments in your programs with our DOCUMENT EXTRACTOR. *Call for more info.* **Pre-processor $29.95. Document Extractor $19.95. *BOTH* for $39.95.** Includes manual.

HADDICK & HADDICK
P.O. Box 1586, Mexia, TX 76667 **817-562-3444**

Inquiry 777.

EditingTools 2.1

Now you can have a slick full-screen multifile text editor for only $35. Enjoy the ease of editing many files at once and the freedom of moving text among files. File sizes are limited only by memory. With an easily reconfigurable keyboard and a convenient multidirectory DOS shell. Add $4 for s/h.

Jou Laboratories
P.O. Box 460969, Garland, TX 75046
214-495-8862

Inquiry 778.

COPY AT TO PC

The 1.2mB drive has long been known to READ but NOT reliably WRITE on 360kB floppies. With **"CPYAT2PC"™** 1.2mB drives CAN reliably WRITE 360kB floppies saving a slot for a second hard disk or backup tape. "CPYAT2PC" (Not Copy Protected) offers 'the preferable SOFTWARE SOLUTION.' *ONLY $79+$4* S/H VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS
655 Skyway, San Carlos, CA 94070
Order toll free **1-800-621-0851 x777**
415-593-8777 (CA) **212-334-1858 (NY)**
TELEX EZLNK 62873089 Dealer inquiries invited

Inquiry 779.

PAL FOR SIDEKICK!

Personal Appointment Locator automatically shows coming appointments, searches your file, maintains to-do list, automatically repeats appointments, examines multiple files. Resident alarm too! Only **$49.95.** Cheap at twice the price!

PAL SOFTWARE
Ste. 12B 110 Green St., New York, NY 10012
(Voice Line) 914-762-5322
(BBS) 914-762-8055

Inquiry 780.

UTILITIES

Recover deleted files fast!

Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk; view, change or create formats, change a file's status, change data in any sector. MS-DOS **$75** U.S. Check/Credit card welcome.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

Inquiry 781.

HANDS OFF™ PC SECURITY

- Locks Hard Disk. - Restricts Floppy Use.
- Protects Subdirectories.
- Normal Use of DOS Commands and Application Software.
- IBM PC, XT, AT and True Compatibles.
- DOS V2.0 and Higher. Hard Disk System.
- Keep Other People's HANDS OFF Your System
- **$89.95** VISA/MC

SYSTEM CONSULTING, INC.
314 Canterbury Dr., Pittsburgh, PA 15238
(412) 963-1624

Inquiry 782.

2 FER

RAINBOW allows you to examine all 64 EGA colors & utilize the ones of your choice. Resident/Non-resident operation for color modification of most programs, fully menu driven color examination & selection process, & executable file creation for command line or batch file color setup. EGA & DOS 2.0 or greater.
EXTENDED DOS COMMANDS include Copy, Move, Delete, & Rename w/two additional switches. One for operation on all files except the ones that match your filespec, & another to prompt a Y/N response prior to operating on any file matching your filespec. DOS 3.0 or greater.
IBM PC/XT/AT or true compatibles. All for only $29.95 + $2.50 S&H. Check/Visa/MC

UNICORN SOFTWARE DEVELOPMENT
P.O. Box 1353 Blue Springs, MO 64015 **(816) 229-7661**

Inquiry 783.

WORD PROCESSING

HEBREW / GREEK / ARABIC

Russian and European Languages. Full featured, multi-language word processor supports on-screen foreign characters with no hardware modifications. $350 (dot matrix) or $500 (laser) + $5 s/h. Or send $15 + $4 s/h for demo. Req. 512K/graphics

Gamma Productions, Inc.
710 Wilshire Blvd., Suite 609, Santa Monica CA 90401
(213) 394-8622

Inquiry 784.

DuangJan 1.3

Bilingual word processor for English and one of these: Armenian, Bengali, Euro/Latin, Greek, Hindi, Khmer, Lao, Russian, Tamil, Telugu, Thai, Viet, . . . , or create your own language with font editor. $69 + $4 s/h (+ $10 for.) LaserJet + $49. Demo $5. IBM compatibles.

MegaChomp Company
3524 Cottman Avenue, Philadelphia, PA 19149-1606
(215) 331-2748/8138

Inquiry 785.

PC-Write™ Shareware Ver. 2.71

Fast, full featured word processor/text editor for IBM PC. With spell check, screen clip, mailmerge, split screen, ASCII files, macros. Easy to use. Supports 400 printers - LaserJet+ and PostScript. Software, User Guide, and Tutorial on 2 disks for $16. Try it, then register with us for only $89 and get User Manual, 1 year tele-support, newsletter and 2 upgrades. 90-day guarantee. VISA/MC.

***Quicksoft* 1-800-888-8088 CALL TODAY!**
219 First N., #224-BYTC, Seattle, WA 98109

Inquiry 786.

THE BUYER'S MART

WORD PROCESSING

Laser Print Envelopes!
The Star*Lite Envelope Printer takes the hassle out of envelope printing on your laser printer. Pops up inside most word processors, SK and Lotus. Batch processing with SDF and ASCII files. PS/2 compatible! Supports HP and most lasers. **$89 + $5 S&H.** Visa OK.
TSG Technical & Systems Group, Inc.
P.O. Box 11895, Newington, CT 06111
Information: (416) 858-1885

Inquiry 787.

PROGRAMMER'S TOOLS

AMADEUS AND MODULA-2
For better programming Modula-2
Amadeus is a complete and powerful environment for developing applications in M2 (Logitech) on PCs. Amadeus includes an application editor with mask/code generator and a run-time support composed of 25 modules which supply windowing, ISAM database, improved interface for Btrieve, menus creation, full I/O procedures, special support of the HP/Vectra (touch screen...) and much more...
Developers: Amadeus will increase your efficiency. Ease of use of dedicated database programs with the power of M2 programming was the aim. With complete manual. **Only $345!** Free demo disk available.
ID NOUVELLES SA
CP 877, 1001 LAUSANNE, SWITZERLAND

Inquiry 788.

ADVERTISE YOUR COMPUTER PRODUCTS HERE
for as little as **$375** in
THE BUYER'S MART
For more information call
Mark Stone at BYTE
603-924-3754

Advertise *your* computer products in **THE BUYER'S MART.**
It's easy to get your sales message into print. Just send us typewritten copy or phone in your ad.
And as a unique feature, every **BUYER'S MART** ad is assigned a reader service number which will provide your company with valuable inquiries.
Call Mark Stone for more information at ***603-924-3754***

BYTE/McGraw-Hill
One Phoenix Mill Lane
Peterborough, NH 03458

TRI STATE COMPUTER

160 BROADWAY, NEW YORK, NY 10038
(Bet. Maiden Lane and Liberty St.)
(212) 349-3134 • Open weekdays 9–6, Sunday 10–4
CALL TOLL FREE ORDERS ONLY 1-800-221-1926

MC & VISA ACCEPTED
NO ADDITIONAL CHARGE

IBM XTs & Sys/2 Mod. 50's
ENH XT — (Model 286)
• 640K 80286 6 MHz.
• 1.2 Drive IBM 20 MB HD
• IBM Keyboard **CALL**

System 2 Model 50
• 80286 10MHz processor
• 1MB RAM standard
• Built-in parallel & serial ports
• 20MB hard disk
• 1.4MB 3½" drive
• Enhanced keyboard **$2649.95**

Enhanced AT 339
• 512K 1.2 FD
• IBM 30MB HD
• IBM Keyboard **$3299.95**

COMPAQ Portable III
Model 20
• 640K 1.2 FD 12 MHz
• 20 MB 40 **$3749.95**
Mod. 40 w/40 MB HD **$4699.95**

Leading Edge Model D
• 512K Dual Floppy
• Keyboard
• Monitor **$899.95**
w/20 MB **$1149.95**

NEC Power Mate I 20 MB
• AT Compatible
• 640K 80286 8 MHz
• 1.2 FD, DOS
• HD controller card **$1599.95**

SUPER SPECIALS
Seagate ST 225 w/cont. **299.95**
Plus 20 MB **579.95**

MODEMS
EVEREX 1200B **99.95**
EVEREX 2400B **179.95**
EXTERNAL 1200 ..... **129.95**
EXTERNAL 2400 ..... **249.95**

HP Laser Jet Series II
w/toner **1649.95**

PRINTERS

IBM Pro Printer XL	$509.95
IBM Pro Printer II	$359.95
Epson LX 800	CALL
Epson FX 86E	$299.95
Epson FX 286E	$414.95
Epson LQ 800	$414.95
Epson LQ 1000	SPECIAL
Epson EX 800	$349.95
Epson EX 1000*	$384.95
Epson LQ 2500	$829.95
Panasonic KXP 1080i	SPECIAL
Panasonic KXP 1091i	$154.95
Panasonic KXP 1092i	$264.95
Panasonic KXP 1592	$344.95
Panasonic KXP 1595	$374.95
Panasonic KXP 3131	$223.95
Panasonic KXP 3151	$349.95
OKI ML 293e	$459.95
OKI ML 292e	$334.95
OKI ML 192	$259.95
OKI ML 192 Plus	$279.95
OKI ML 193 Plus	$404.95
OKI ML 294	$699.95
NEC P6	$399.95
NEC P7	$569.95
NEC P9	$999.95
Toshiba 341-SL	$649.95
Toshiba 351-2	$799.95
Toshiba 321 SL	$459.95

AT&T 6300
6300 1 - 360K FD
• 640K RAM, • Graphics Card
• Clock/Calendar
• Keyboard **$849.95**
w/20 MB HD **$1149.95**

Epson Equity I Plus
• 640K Dual Floppy
• Parallel Serial Ports
• DOS & Basic
• Keyboard, • Video Board
• Mono Monitor **$949.95**
w/20 MB **$1199.95**

Epson Equity II
• 640K 1 360K FD
• Parallel Serial Ports
• DOS & Basic
• Keyboard, • Video Board
• Mono Monitor **$949.95**
w/20 MB **$1249.95**

*after mfg. rebate

Laptop Computers

Toshiba T3100	2599.95
Sharp PC 7100	1849.95
Zenith Z-181	1599.95
Zenith Z-183	2299.95
NEC Laptop	1299.95
Brooklyn Bridge	89.95

Apple Computers

Apple II GS	689.95
Apple RGB Monitor	399.95
Macintosh Plus	1599.95
Mac SE Dual Floppy	2099.95
Mac SE Hard Drive	2599.95
SE Keyboard	109.95
Imagewriter II	449.95

MX 286 TURBO
• AT Compatible
• 80286 6 & 10 MHz
• 1.2 FB, • 0 Wait State
• Phoenix Bios
• 1 year warranty **$949.95**

MX TURBO XE
• 640K 1–360K FD
• Serial & Parallel Port
• Game Port, • Video Board
• Mono Monitor **$569.95**

All items subject to availability and price changes. Mail and phone orders C.O.D., MC and VISA, S&H extra. Not responsible for typographical errors. All systems fully tested and installed by Tri State Computer. Printer price w/purchase of cable only.
Special to BYTE readers — Full Size Printer Stand $12.95

	1985	1986	1987
Jan.	$4.25		
Feb.	$4.25	$4.25	$4.25
March	$4.25		$4.25
April	$4.25		$4.25
May	$4.25		$4.25
June	$4.25	$4.25	$4.25
July		$4.25	$4.25
Aug.	$4.25	$4.25	$4.25
Sept.	$4.25	$4.25	$4.25
Oct.	$4.25	$4.25	
Nov.	$4.25		
Dec.	$4.25	$4.25	

BACK ISSUES FOR SALE

SPECIAL ISSUES and INDEX	
BYTE '83–'84 INDEX	$1.75
BYTE 1985 INDEX	$2.00
1984 SPECIAL GUIDE TO IBM PCs (VOL. 9, NO. 9)	$4.75
1985 INSIDE THE IBM PCs (VOL. 10, NO. 11)	$4.75

Circle and send requests with payments to:

BYTE Back Issues
P.O. Box 328
Hancock, NH 03449

☐ **Check enclosed** *Payments from foreign countries must be made in US funds payable at a US bank.*

☐ **VISA** ☐ **MasterCard**

CARD # _____ EXP. DATE _____

SIGNATURE _____

The above prices include postage in the US. Please add $ .50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries (surface delivery). Please allow 4 weeks for domestic delivery and 12 weeks for foreign delivery.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

SATISFACTION GUARANTEED OR YOUR MONEY BACK!

8 MHz TURBO-XT

- 640K of RAM
- 360K Disk Drive
- 150 Watt Power Supply
- 4.77 & 8 MHz
- 8 Slots
- Deluxe Keyboard
- Disc Controller

OPTION A
- High Resolution Amber Flat Screen
- High Resolution Graphics Card
- Parallel Printer Port

ADD $148

$398

OPTION B
- Hi-Res RGB Color Monitor
- High Resolution Graphics Card
- Parallel Printer Port

ADD $298

OPTION C
- 21.3 Megabyte Hard Disk Drive
- Dual Hard Disk Controller Card

ADD $298

Turbo-AT

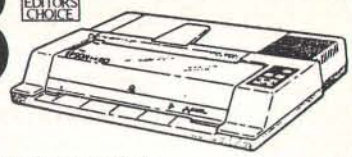
- 640K of RAM Expands to 1 MB
- 200 Watt Power Supply
- AT-Style Keyboard
- One Year Warranty
- Clock/Calendar

$798

EPSON PLOTTER
FOUR PEN/FOUR COLOR

$198

PC MAGAZINE EDITORS' CHOICE



List Price $599

Limited Quantity

- Fast - 9 Inch Per Second
- Accurate - .1 mm Step Size
- Four Pen/Four Color
- Automatic Pen Capping
- Standard Parallel Interfacing
- Accepts Paper or Transparancies
- One Year Epson Warranty

4 Waterbase Pens ____ $5
4 Oil Base Pens ____ $5
100 Sheets Coated Paper ____ $5
10 Sheets Overhead Transparency Film ____ $6
Top Rated Business Graphics Software Packaged for PC ____ $29
Parallel PC Cable ____ $19
HPGL Emulation ____ $69

1200 BAUD DELUXE MODEM

$78

Including Free Software

EGA PACKAGE

$498

List Price $998

Hi-res EGA Video Card... $148
Hi-res EGA Monitor... $378
- Dual Mode Monitor
- Non-glare .31 mm Dot Pitch
- 640 x 350, 640 x 200
- EGA, CGA, MDA & HGA
- 100% IBM Compatible
- 256K of Video RAM

HI-RES RGB MONITOR

$289

List Price $699
- 640 x 240 14" Non-glare Tube
- 16 Color, .39 mm Dot Pitch
- Includes Free Cable & Tilt-n-Sviwel

Manufactured By Samsung

21 MB CARD

40 MB CARD $498

$358
- 21.3 MB Formatted
- Lowpower
- Head Park Zone
- Plated Media
- Light 2.4 Lbs.

HARD DISK SALE

10 Megabyte

$198

Including Controller

20 MB ____ $288
30 MB ____ $338
30 MB AT _ $499
40 MB AT _ $599

360K DISK DRIVE

½ Ht. Qume/Alps Built to IBM Specs

$65

Limited Quantity

10-30 **$62.50**
30+ **$59.50**

EPSON® PRINTER

$148

List Price $299 — **Limited Quantity**

LX-86, LX-800, FX-86e, FX-286e, LQ-800, LQ-1000, EX-800, EX-1000, LQ-2500, GQ-3500

Call For Our Best Price!

NEC MULTISYNC

$529

13" Color Monitor

NEC MULTISPEED

$1388

Lap-Top Computer

Tandon

360K Disk Drive

½ Ht. Direct Drive TM65-2 **$79**

Full Height TM100-2 **$98**

Letter Quality DAISYWHEEL PRINTER

26 CPS Diablo Compatible **$198**

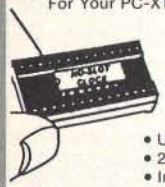
Tractor...$69 Sheet Feed...$159

OKIDATA LASER PRINTER

$1398

NO-SLOT CLOCK

For Your PC-XT (Clone) or Apple



$49
- Uses No Slots
- 20 Year Battery
- Includes Software

Plug-in Clock Board for PC.....$49

intel

Math Co-Processor

8087 ____ $99
8087-2 ____ $149
8087-1 ____ $199
80287 ____ $179
80287-8 ____ $249
80287-10 ____ $299

3½" DISK DRIVE

FOR YOUR PC/XT/AT

$149

720K Disk Drive For Mass Storage or for Down Loading to your Lap-Top Computer

Requires DOS 3.20

Includes Mounting Kit

HEWLETT PACKARD LASERJET II

$1748

List Price $2595

JADE COMPUTER

4901 W. Rosecrans Ave. Box 5046
Hawthorne, CA 90251-5046

VISA MasterCard AMERICAN EXPRESS

PLACE ORDERS TOLL FREE!
Continental U.S.A. (800)421-5500
Inside California (800)262-1710
Tele Fax (213) 675-2522

Prices at our six store locations will be higher.
We accept cash, checks, credit cards or purchase orders from qualified firms and institutions. Minimum prepaid order $15.00.

Ca. & Tx. residents add sales tax. **Prices & availability subject to change without notice.** Shipping & handling charges via UPS Ground 50¢/lb. UPS Air $1.00/lb. **Minimum charge $3.00.**

Circle 58 on Reader Service Card

DiskMASTER®

The Ultimate Diskette Value ...

Discover the Difference ...

2 FOR 1 LIFETIME WARRANTY

NOW IN COLOR

- ✓ Backed by 2 for 1 Lifetime Warranty
- ✓ 100% tested and certified
- ✓ Made to exceed A.N.S.I. specs by 62.5% with a guaranteed clipping level of 65% or above
- ✓ Packaged in 6 different colors, bulk or boxed
- ✓ Includes tyvek envelopes (not paper), write protect tabs and user labels
- ✓ Brand-name quality at affordable prices

5-1/4" - 48 TPI DS-DD		DS-HD 96 TPI IBM-AT Compatible
.49	BULK COLOR OR GRAY	1.09
.59	BOXED COLOR	1.19

Simply top Brand-Name Quality, made in the U.S.A. by a leading manufacturer. Factory polybagged in lots of 20 (min order 40)

CenTech®

America's Premium Quality Color Diskettes

- ✓ TIMELESS WARRANTY
- ✓ Performance exceeds A.N.S.I. spec. by 88%
- ✓ Each disk 100% tested and certified
- ✓ 14 COLORS for data organization
- ✓ Pkgs. of 10 tyvek sleeves, w/p tabs, & ID labels

5-1/4" - 48 TPI DS-DD		DS-HD 96 TPI IBM-AT Compatible
.97	PLASTIC STORAGE BOX COLOR	1.85
.77	BULK COLOR	1.75
3-1/2" Color, DS, 135 TPI Plastic Storage Box		1.79

3M

America's No. 1 Name-Brand Diskettes

5-1/4" - 48 TPI DS-DD	DS-HD 96 TPI IBM-AT Compatible
.84	1.77

With FREE Platen Cleaner

Nashua

5-1/4" - 48 TPI DS-DD		DS-HD 96 TPI IBM-AT Compatible
.54	BOXED	1.45

BULK

32¢ 5-1/4" DS/DD 48 TPI Exceeds ANSI specifications + 6¢ FOR TYVEK

ORDERING INFORMATION

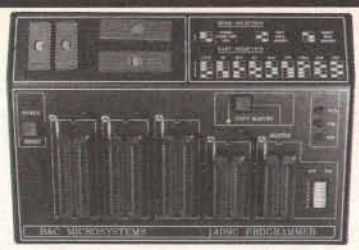
TERMS: Free use of VISA, Mastercard, and American Express. P.O. orders accepted from recognized corporations rated 3A2 or better, government and schools on net 30. **SHIPPING:** U.S. orders add $3.00 per 100 diskettes or fraction thereof, add $5.00 for COD orders.

PRICE PROMISE: We will better any lower delivered price on the same products and quantities advertised nationally.

Toll Free Order Line: **1-800-233-2477**

Information Line: **1-801-561-0092**

Computer Affairs, inc.
199 COTTAGE AVE.
SANDY, UTAH 84070
HOURS: 8 AM TO 5 PM (MTN. TIME)



UNIVERSAL EPROM PROGRAMMER $495!!

- * Built in timer **eraser** optn; foam pad area
- * Menu selection; **No personality modules**
- * User friendly softw; Complete help menu
- * Direct tech. support; Full 1 yr. warranty
- * Stand alone duplication & verify;
- * Quick pulse algorithm: 27256 under 60 sec
- * All 24/28 pins to 27011 & CMOS E(E)PROMS
- * Micros: 8741, 2, 4, 8, 9, 51, 52, 55, 9761 & CMOS
- * Auto baud RS232 to 19.2k; **Free PC drivers**
- * Ofset/split Hex, Binary, Intel & Motorola 8, 16 & 32 bit files: **Kits from $95!**

B&C Microsystems
355 W. Olive Ave., Sunnyvale, CA 94086
* Ph 408-730-5511 Visa & MC

Circle 39 on Reader Service Card

TERMINAL EMULATIONS

NEW RELEASE

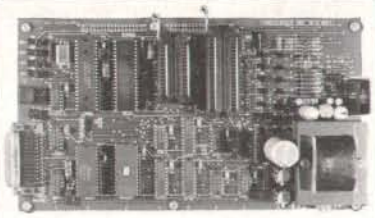
SOFTERM PC, THE LEADER IN EXACT TERMINAL EMULATIONS

* OVER 30 EMULATIONS
- * KEYBOARD MACROS
- * HOTKEY
- * VIRTUAL DISK CAPABLE
- * SCRIPT FILES
- * KEYBOARD TRANSLATE
- * MULTITASKING
- * CAPTURE FILES TO DISK OR PRINT
- * FILE TRANSFERS WITH 7 PROTOCOLS (I.E. KERMIT-SERVER,HAYES,XMODEM,ETC.)
- * CONCURRENT AND BACKGROUND COMMUNICATIONS AND MORE!!!

A COMPLETE EMULATION & COMMUNICATION PACKAGE

SOFTRONICS
800/225-8590
CALL FOR INFORMATION
(303)593-9540 TELEX 450236

Circle 253 on Reader Service Card



UNIVERSAL EPROM PROGRAMMER KIT FROM $95!!

- * On board power supply, 110/220 VAC;
- * Menu selection; **No personality modules;**
- * Built in monitor for easy I/O debugging;
- * User friendly softw; Full tech. support
- * Detailed 50 page manual with schematics;
- * Quick pulse algorithm: 27256 under 60 sec
- * All 24/28 pins to 27011 & CMOS E(E)PROMS
- * Micros: 8741, 2, 8748, 48H, 49, 49H & CMOS
- * Auto baud RS232 to 19.2k; **Free PC drivers**
- * Ofset/split Hex, Binary, Intel & Motorola 8, 16 & 32 bit files; **Cased unit $495!**

B&C Microsystems
355 W. Olive Ave., Sunnyvale, CA 94086
* Ph 408-730-5511 Visa & MC

Circle 40 on Reader Service Card

8080 Z80 HD64180 CP/M-80

D64180

Develop code for embedded microprocessors on your IBM-PC using our software tools and coprocessor cards. Test your software on our Z80 and HD64180 coprocessor cards. Execute your CP/M-80 development tools at clock speeds up to 12.5 MHZ! Use our remote debugger to debug in your target system. Complete development systems for less then $1000.

Z-World
1772A Picasso Ave.
Davis, CA 95616
(916) 753-3722

In Germany: iSystem Tel: 08131/1687

Circle 304 on Reader Service Card

Dealers!

Network-OS LAN Systems - Includes Boards, Cabling, Terminators and Software. Two-user hardware and software for under $1,000 list!

Close-Up Remote Communications - Support your customer without leaving your office. Authored by **Cogitate** for Norton-Lambert!

Context Sensitive Help for *DataFlex, RM/COBOL, Clipper* and *dBase III* - Puts your application's documentation "on line."

DataFlex Database Management - True Multi-User database for MS/PC-DOS, Unix and Xenix. Site licensing available.

Dump/Restore-XT - Seven utilities for the MS/PC-DOS user.

Call or write today for our catalog and pricing!

COGITATE, INCORPORATED
"A Higher Form of Software"
24000 Telegraph Road
Southfield, MI 48034
(313) 352-2345/Telex: 386581
Visa/MasterCard Accepted

Circle 52 on Reader Service Card

C

See how well you can program for

Z80 or HD64180

This professional, IBM-PC based, compiler is a complete implementation of the "C" language for the Z80 or HD64180 microprocessor. Includes features such as: function prototyping, 31-character names, single precision floating point, full library source, M80-L80 and SLR Systems compatibility, etc. Hi-Tech™ "C" has been established for years in Australia. Pricing from $195.00. We also have Z80/HD64180 co-processor cards for IBM-PC and PC/AT. Call for a full catalog of Miicroprocessor development tools.

Z-World
1772A Picasso Ave.
Davis, CA 95616
(916) 753-3722

"Z80 Specialists"

In Germany: iSystem Tel: 08131/1687

Circle 305 on Reader Service Card

PC COMPATIBLE SYSTEMS

AST Model 170	$ 2,795
AST Model 140	$ 2,445
AST Model 120	$ 2,095
Fortron 386	CALL
EasyData *SUPERturboXT*	$ 439
EasyData Boards	
EasyData MGP	$ 48
EasyData CGP	$ 59
EasyData EGA	$ 135
EasyData IOC	$ 75
EasyData MUL	$ 79
EasyData Baby-AT....From (Small footprint, 10 MHz)	$ 719
Indtech 5170 Basic System (12 slots, WA2 controller, runs Novell non-dedicated 286)	$ 1,195
WYPC-286 PC	$ 1,488
WYPC-286 PC85 - w/85 Mb	$ 2,379
WYPC-286 PC20 - w/20 Mb	$ 1,759
WYSE 386	CALL

MONITORS & TERMINALS

AST WYSIWYG	$ 1,197
Samsung EGA	$ 365
Samsung 14" RGB	$ 249
Samsung 12"	$ 79
Tatung CM-1365 RGB	$ 319
Tatung CM-1380F EGA	$ 429
Tatung MM-1422	$ 125
NEC Multisync Monitor	CALL
WYSE WY700 1280 x 800	$ 749
WYSE 30 Terminal	$ 329
WYSE 50 Terminal	$ 388
WYSE 60 Terminal	$ 419

MODEMS

CTS 2424 ADH	$ 248
CTS 2424 AMH	$ 328
CTS Half-Pak 2400 - 1/2 Card	$ 219
EasyData 1200-PC Half Card	$ 88
EasyData 2400-Full Card	$ 178
EasyData 1200D-External	$ 97
EasyData 2400D-External	$ 187
MultiTech	CALL
ProModem 1200B	$ 109

S-100

800-528-3138
Orders Only
602-991-7870 Technical

"THE PC PEOPLE"
10th anniversary specials

FEDERAL EXPRESS FREE WHEN YOU PAY GROUND RATES!* NO SURCHARGE!

PRINTERS

Brother M-1709	$ 415
FREE Freight in the US	
Brother M-1509	$ 343
Brother M-1109	$ 189
Brother HR-40	$ 569
Brother HR-20	$ 339
Panasonic 1080i	$ 185
Panasonic 1091i	$ 239
Panasonic 1092i	$ 315
Panasonic 1592	$ 379
Panasonic 1595	$ 459
Panasonic 3131	$ 265
Panasonic 3151	$ 390
Toshiba P351 - Model 2	$ 969
Xerox/Diablo 635	$ 729

PLOTTERS

Houston Inst. DMP 41/42	$ 2,309
Houston Inst. DMP 51/52	$ 3,499
Houston Inst. DMP 56A	$ 4,399
Houston Inst. DMP 29	$ 1,699
Houston Inst. DMP 40	$ 888
Houston Inst. ScanJet	$ 2,359

LASER PRINTERS

AST TurboLaser	$ 2,695
Cordata LP-300	$ 1,649
Genicom 5000 - 8 Pgs/Min.	$ 1,599
H.P. LaserJet Series 2	$ 1,799
Okidata Laserline 6	$ 1,488
Q.M.S. - PS-800+	$ 4,399
Texas Instruments	CALL
Xerox 4045 Model 50	$ 3,595

BOARDS

AST 6-PAK Premium/256K	$ 159
AST RAMPAGE-286-512K	$ 378
AST Hot Shot 286-10XT	$ 369
AST RAMvantage 128K-2 Mb	$ 188
AST ADVANTAGE-128K	$ 325
AST 3G-PLUS	$ 225
Intel Above Board/286	$ 349

POWERS SYSTEMS & SOFTWARE

CACO P-15 Monitor Base	$ 75
Power Savers by Topaz-From	$ 459
Ventura Version 1.1	$ 488
NewWord -Like WordStar v4.0	$ 149

14455 NORTH 79TH ST. SCOTTSDALE, AZ 85260
TELEX 9103806778 SONEHUND FAX 602-483-0920

Advertised prices are cash, prepaid. VISA, M/C Only! Customers qualifying for terms calculate addl charges in the following way: P.O.'s & AMEX ÷ .95; C.O.D.'s ÷ .99. Shipping first 6 lbs. min. $6.00. Sales tax AZ res. only. All returns subject to a restocking fee or full credit towards a future purchase. All prices subject to change without notice *Free FedX only applies to orders from 1-9 lbs & over $50

CONNECTIVITY

3-User Network Special
NOVELL
Server/Work Station:
INDTECH 6/8 MHz 286, 12 slots, 238Watt P/S, S&P Ports, Monitor, 1.2 Mb & 360K Floppy, 1 Mb RAM, 71 Mb @ 28mSEC H.D.
NOVELL Non-Ded. NetWare 286
ArcNet 4-Port Passive Hub
3 ArcNet Cards & Cables to 100' ea
2 EasyData *SUPERturboXT* 640K, 10MHz, 8088-1, "AT-Style" keyboard, "FCC" approved. 3-Amber monitors included.
** A COMPLETE NETWORK **
Retail $ 9,258 *Now Only $ 5,395*

ArcNet Compatible Card	$ 195
ArcNet 8-Port Active Hub	$ 395
ArcNet 4-Port Active Hub	$ 195
ArcNet 4-Port Passive Hub	$ 35

WESTERN DIGITAL

StarLAN/Novell Starter Kit	$ 1,095
StarHub	$ 329
StarCard	$ 175
StarCard Plus	$ 195
StarLink Card	$ 195
EtherCard Plus	$ 265

DRIVES

Everex 60i 60 Mb Tape	$ 739
Fujitsu 360K	$ 85
Irwin 20 Mb Tape	$ 465
Micropolis 85 Mb	$ 898
Mitsubishi MF501 48 TPI	$ 91
Mitsubishi MF504 96 TPI	$ 129
Priam ID130	$ 2,195
Priam ID75	$ 1,079
Priam ID100	$ 1,239
Priam ID230	$ 2,888
Priam V150	$ 699
Seagate 20 Mb PC Subsystem	$ 299
Seagate 30 Mb PC Subsystem	$ 388
Seagate ST-251	$ 525
Teac FD-55-BV	$ 89

Computer Valley

Computer Valley

800-225-8216 (orders only) **408-739-3400** (CA res. & info.)
1290 Oakmead Parkway, Suite 111 • Sunnyvale, CA 94086
New England
617-664-6994 • 1-800-648-7411 212 Main Street N. Reading, MA 01864

80386 PERSONAL COMPUTER $2,590

IDEAL FOR CAD/CAE/CAM/CAT WORKSTATIONS

- 2MB Memory Expandable to 16MB
- 2 Serial Parallel Ports
- On Board Socket for 80287
- 101 Keys Enhanced Keyboard
- FORTRON® 230 Watt Power Supply UL Listed
- 5 Drives Capacity Heavy Duty Cabinet
- 1.2MB TEAC Floppy Drive
- Western Digital Controller
- DOS 3.2/GW Basic
- One Year Warranty

Intel iSBC 386 Compatible

Made in U.S.A.

PACT-286-8 $995

8 MHz ZERO WAIT STATE

- IBM AT Compatible • 6/8 mhz 0 Wait State, Norton S/I 9.2
- 512K Installed, Expandable to 1MB On Board Memory
- 1.2MB Floppy Drive • Floppy and Hard Disk Drives Controlle
- 230 Watt (max.) UL Listed Power Supply • DOS 3.2 GW Basic
- Clock/Calendar with Battery Back Up
- Optional: 2 Serial and 1 Parallel Port • Math Co-Processor 80287-8
  5 Half-Height Drives Capacity Chassic
- One Year Warranty

PACT-286-10 $995

10 MHz ONE WAIT STATE*

PACT-286-12 $1,195

6/12 MHz DUAL CLOCK SPEED*

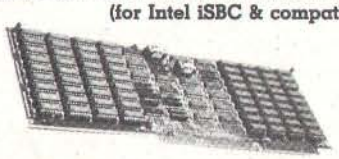
*Same configuration as PACT-286-8 with 640K memory installed.

- Prices subject to change without notice.
- Intel iSBC is a trademark of Intel Corporation.
- IBM XT, AT is a trademark of International Business Machines.

TERMS:
- Shipping and handling charge starting from minimum $6.00 each shipment.
- 15% restocking charge is required for nonauthorized return merchandise.

2MB 32 BIT WIDE DATA BUS Memory Exp. Board

(for Intel iSBC & compatible 80386 system)



$590 each
w/2MB On Board

VIDEO BOARD

MGP $69

Monographics adapter with printer port

EGA $149

IBM® EGA, CGA, MDA compatible

SUPER EGA $219

132 Column • Alphanumeric
IBM® EGA, CGA, MDA compt.
Super hi-res. 640×480
640×350, 720×348

TAPE BACK UP

20MB Internal	$459
20MB External	$559
60MB Internal	$550
60MB External	$650

DISK DRIVES

TEAC 360K Floppy	$ 85
TEAC 1.2MB Floppy	$109
TEAC 40MB H.D.D.	$675
Chino 1.2MB Floppy	$ 99
Seagate ST-225 Kit	$299
Seagate ST-4038 Kit	$625
Seagate ST-4051 Kit	$725

MATH CO-PROCESSOR

8087 (5 MHz)	$105
8087-2 (8 MHz)	$152
80287-6 (6 MHz)	$174
80287-8 (8 MHz)	$245
80287-10 (10 MHz)	$300
80387-16 (16 MHz)	$590

KEYBOARDS

MAXI SWITCH

Enhanced 101 Key $75.00
XT/AT 84 Key $65

PANASONIC PRINTER

KX-P1080I 120cps, NLQ	$195
KX-1091I 160cps/32cps NLQ	$245
KX-1092 180cps/33cps NLQ	$295
KX-1592 180cps/38cps NLQ	$409
KX-1595 240cps/51cps NLQ	$530
KX-P3131 17cps Daisywheel	$245
KX-P3151 22cps LQ Parallel Printer	$382

POWER SUPPLY

DIRECT REPLACEMENT IBM XT, AT

200W AT Power Supply $139
150 W XT Power Supply $ 89

Circle 30 on Reader Service Card (Dealers: 31)

FCC APPROVED!

Sub-Mini AT!
The Space Saver
3-DR. Capability
8-Expansion Slots!

Comes with:

- 1 ea. 1.2MB high density floppy drive
- Floppy & HD controller
- 512K RAM (Expandable to 1M)
- 200-watt power supply
- AT Style keyboard
- Assembled & Tested
- Expansion options available

Order # MAT-1 **$1,079.00**

XT Turbo Basic System

- 4.77/8MHz keyboard selectable
- 8 expansion slots
- Award Software BIOS
- XT Style slide case
- 256K RAM Expandable to 640K)
- XT Style keyboard
- Assembled & Tested
- Expansion options available

Order # XT-TURBO-1
$290.00

AT Turbo Basic System

- 6/10MHz (8/12MHz option)
- 8 expansion slots
- Award Software BIOS
- 512K RAM (Expandable to 1M)
- 1.2MB high density floppy drive
- Floppy & HD controller
- 200-W power supply
- AT Style keyboard
- Assembled & Tested
- Expansion options available

Order # AT-TURBO-1
$1,025.00

PERIPHERALS

1.	Floppy Disk Controller - 2Dr.	$29.00
2.	Floppy Disk Controller - 4Dr.	$34.00
3.	WDC H.D. Controller	$75.00
4.	WDC H.D. Controller - RLL	$105.00
5.	Floppy & HD Controller - XT/AT	$165.00
6.	WDC Floppy & HD Controller	$165.00
7.	0-384K Multifunction Card	$79.00
8.	Multi I/O (Ser/Par/Game/Clk)	$58.00
9.	Multi I/O With Controller	$75.00
10.	Multi I/O For AT (Ser/Par/Game)	$55.00
11.	0-640K RAM Card	$45.00
12.	0-2M EMS RAM Card For XT	$99.00
13.	0-2M EMS RAM Card For AT	$119.00
14.	Color Graphics Card	$45.00
15.	Color Graphics Card W/Printer	$55.00
16.	EGA Card (Made in USA)	$175.00
17.	Mono Gr. Card W/Printer	$55.00
18.	XT Motherboard W/BIOS (0K)	$99.00
19.	XT Turbo Motherboard W/BIOS	$119.00
20.	6/10 MHz AT Motherboard	$450.00
21.	8/12 MHz AT Motherboard	$510.00
22.	6/12 Mini AT Motherboard	$510.00
23.	XT Style Keyboard	$49.00
24.	AT Style Keyboard (AT/XT)	$59.00
25.	Enhanced Keyboard (AT/XT)	$79.00
26.	150-watt Power Sypply	$55.00
27.	150-watt Power Supply-UL	$70.00
28.	200-watt Power Supply-UL	$99.00
29.	XT Flip Top Case	$33.00
30.	XT Slide Case	$37.00
31.	XT Slide Case (AT Style)	$55.00
32.	AT Slide Case	$68.00
33.	Mini AT Slide Case	$68.00

ORDER HOT LINE **1-800-543-5107**
Technical Information **(714) 990-2097**

JAWIN COMPUTER PRODUCTS
565 W. Lambert Rd., #C
Brea, CA 92621

Terms: Please add 5% (or $2.00, whichever is higher) plus .25¢ for each $100.00. CA residents please add 6% sales tax. We accept VISA/MC/Cash. personal checks please allow 2 weeks to clear. All merchandise is warranted for 1 year unless otherwise stated.

PC + MIDI = MUSIC

It's a simple equation. To plug your PC or PC-compatible into the modern world of music-making, use the complete line of MIDI soft ware and hardware from **VOYETRA TECHNOLOGIES.**

- ☐ **SEQUENCER PLUS:** 65-track total MIDI recorder/editor.
- ☐ **CONVERSION PLUS:** file converter for music notation programs.
- ☐ **PATCH MASTER:** network organizer and sound librarian.
- ☐ **OP-4001:** PC/MIDI interface card.

"I've never seen a more powerful, easy-to-use music and recording system . . . bug-free."
(PC COMPANION)

For more information contact **VOYETRA TECHNOLOGIES,** Dept. PC, 426 Mt. Pleasant Avenue, Mamaroneck NY 10543, or call (914) 698-3377.

Circle 290 on Reader Service Card

NEW IMPROVED
EPROM PROGRAMMER

Made in America

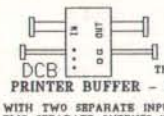
STILL JUST $349

- Now supports over 250 specific EPROM's and EEPROM's from AMD, Intel, SEEQ, TI, Fujitsu, Hitachi, Toshiba, and 21 others.
- Programs 87C51, 8749, 8741A, 8742 and other microcontrollers with optional heads
- Splits 16- and 32-bit files
- 30 day money back guarantee.
- Free PCDOS software runs up to 38,400 baud.
- Gold Textool ZIF socket.
- Same day shipment.

CALL TODAY FOR MORE INFORMATION

BP MICROSYSTEMS
10681 Haddington, #190 / Houston, TX 77043
(713) 461-9430 (800) 225-2102
Telex: 1561477

Circle 36 on Reader Service Card



! not only a printer buffer !

THIS IS THE MOST SOPHISTICATED
PRINTER BUFFER – MULTIPLEXOR – SWITCH

WITH TWO SEPARATE INPUTS (SERIAL AND PARALLEL) AND TWO SEPARATE OUTPUTS (SERIAL AND PARALLEL) CAN BE USED LIKE STANDARD BUFFER... WITH ANY INPUT TO ANY OUTPUT... BUT ALSO YOU CAN CONNECT 2 COMPUTERS TO 1 PRINTER, OR 1 COMPUTER TO 2 PRINTERS, OR 2 COMPUTERS AND 2 PRINTERS... AND MORE = 1 COMPUTER TO 3 PRINTERS OR 3 COMPUTERS TO 1 PRINTER.
HIGH CAPACITY – 64 KB TO 256 KB AND – 256 KB TO 1 MB (MODELS A AND B). PAUSE, COPY AND RESET FUNCTIONS SERIAL PORTS WITH 7 OR 8 BITS WORD LENGTH, 1 OR 2 STOP BIT, PARITY, XON/XOFF, DTR, RTS

DCB-A-64K $ 195 DCB-B-256K $ 255 (*)

(*) Power supply and parallel cables are included

ALSO, WE HAVE THE MOST COMPLETE DATA CONVERTER UNIT CONVERTS RS232 SERIAL TO CENTRONICS PARALLEL OR VICE VERSA, JUST BY MOVING JUMPERS. BAUD RATE AND PROTOCOL FULLY PROGRAMABLE FROM 150 TO 19200 BAUDS INCLUDES : DTR, RTS, XON/XOFF, PARITY, etc

DCU $ 80 (**)

(**) Power supply and cables NOT included

serial◇parallel bi–directional converter

INTECTRA

INTECTRA Inc.–Dept.232
2029 TERMINAL BLVD
MOUNTAIN VIEW-CA-94043
(415) 967–8818 TX 345545

A MUST for Computers

The Ideal Keyboard Cover!

Protect your computer and **eliminate** down-time caused by liquid spills, contaminants, environmental hazards, etc. with VIZIFLEX SEELS - the **only** keyboard cover that:

- **Remains securely in-place** during the operation of the keyboard and will not interfere with computer performance in any way.
- **Is designed to "form-fit"** to the exact contours of the keyboard to provide superior tactile sensitivity & feel for individual keys.
- **Consists of Ultraflex™ material, a transparent, flexible "film"** which allows all "markings" to be clearly visible.

VIZIFLEX SEELS are the **only** keyboard covers for your computer!

VIZIFLEX SEELS, INC.
16 E. Lafayette St., Hackensack, NJ 07601 (201) 487-8080

Circle 288 on Reader Service Card

SEALEVEL
PROUDLY PRESENTS

- **Dual SIO Serial Interface.** Two independent 8250/16450 ports, COM1-N, versatile, RTS and CTS. RS-232/ 422/ 485/ 449 compatible.
- **ACB-II Advanced Communications Board.** SYNC/ASYNC to 880K, DMA, 82530 SCC, RTS, CTS, RXC, TXC signals. RS-232/ 422/ 485/ 449 compatible.

SEALEVEL SYSTEMS INC.
PO BOX 1808
EASLEY, SC 29641 USA
(803) 855-1581

Circle 247 on Reader Service Card

9-Track Tape Subsystem for the IBM PC/XT/AT

Now you can exchange data files between your IBM PC and any mainframe or mini-computer using IBM compatible 1600 BPI 9-Track tape. Unit can also be used for disk backup. Transfer rate is up to 4 megabytes per minute on PCs and compatibles. Subsystems include 7" or 10 ½" streaming tape drive, tape coupler card and DOS or XENIX compatible software.
Prices start at $2,995.

QUALSTAR®
9621 Irondale Ave., Chatsworth, CA 91311
Telephone: (818) 882-5822

Circle 228 on Reader Service Card

Re-ink ANY FABRIC RIBBON automatically for LESS THAN 5 CENTS with MAC INKER™

Over 11,000 cartridges and spools supported!

MAC INKER

IMAGEWRITER I AND II	**$42.00**
UNIVERSAL (cartridge or spool)	**$68.50**
MULTICOLOR IMAGEWRITER	**$80.00**
MULTICOLOR ADAPTER ONLY	**$40.00**

Shipping (first unit) $3.00

■ Lubricated DM INK EXTENDS PRINT-HEAD LIFE! Black, blue, brown, red, green, yellow, purple, orange–2 oz. bottle $3.00; pint $18.50. Gold, silver, indelible and OCR inks available. Heat transfer MacInkers and ink available plus a complete range of accessories for special applications.

■ Top quality, GUARANTEED, double density ribbon cartridges and reloads available.

■ DEDICATED MAC INKERS AVAILABLE FOR EXTRA LARGE OR SPECIAL CARTRIDGES.

A BUFFER AND A DATA SWITCH! PROTEUS™

The "Siamese" Buffer

64K–**$199.00**
256K–**$299.00**
Cable–**$10.00**
Shipping $4.00

■ Proteus directs two printers working simultaneously, and frees your computer for other applications.

■ Now you can merge a form letter with your mailing list, set up one printer with letterhead, the other with envelopes, press "START" and RELAX while

PROTEUS DOES IT ALL–ALL AT ONCE!

■ Compact ■ 2 parallel ports ■ Multiple copy capability ■ "Flexible Capacity" buffer for each port.

1986 "Best Buy of the Year" Award!– Computer Shopper

PRINTER SHARING IN THE PC ENVIRONMENT! KEYDEX

"The Solution"

Priced **$139.00–$360.00**

Shipping $6.00

UG403 shown

■ 4 PC's share up to two printers.
■ Manual or automatic printer selection.
■ Multiple copy capability.

All Keydex products are designed to "PLUG IN AND PRINT." There are no special drivers to add to your system and no complex routines to learn, so little time is lost while users adapt to the new system.

MERCURY MODEM

*100% Hayes™ compatible!

$149.00
Shipping $4.00

■ 24 month warranty ■ Status lights ■ Speaker
■ 300/1200 baud ■ Call progress detection.

Quick Link Communications software:
MS DOS and Macintosh–**$29.95**
with modem–**$15.00** cable–**$15.00**

*Hayes is a trademark of Hayes Microproducts.

DATA SWITCHES

2 Port–**$46.00**
4 Port–**$59.00**
Shipping $4.00

Parallel, serial, 2 or 4 way, crossed, etc.

CABLES: We carry cables for all common computers and peripherals. Rapid turn-around on custom orders. Competitively priced.

ORDER TOLL-FREE 1-800-547-3303

In Oregon (503) 626-2291 (24 hour line)
We are and always will be

Computer Friends®

14250 N.W. Science Park Drive
Portland, OR 97229, Telex 4949559
Dealer Inquiries Welcome.

WHOLESALE PRICE TO PUBLIC!

10 MHz TURBO XT COMPUTER

- 640K RAM On Board
- 2 360K Floppy Disk Drives
- Disk Controller
- 150W Power Supply - 110/220V
- Full Function 'AT' Keyboard
- 8 IBM I/O Slots
- 8088-2 Micro Processor
- Front Panel w/LED and Keylock
- 10MHz/4.77MHz Clock Selectable

Fully Assembled & Tested
1 Year Parts & Labor Warranty..... **$499.00**

PINECOM 'AT' 286 COMPUTER

- 6/10MHz Clock Selectable
- 80286-10 CPU, 0 Wait State
- 220W Power Supply
- 1.2Mb Floppy Disk Drive
- Hard Disk/Floppy Disk Controller
- 512K RAM On Board (Exp to 1Mb)
- Clock Calendar w/Battery Backup
- AT Style Keyboard

Fully Assembled & Tested
1 Year Parts & Labor Warranty..... **$899.00**

*The Land Mark Speed Test, Landmark Software Inc.

pinecom™ SPECIAL SALE PRICES

SEAGATE ST-225 20Mb Hard Drive w/W.D. Controller	$299.00
SEAGATE ST-238 30Mb Hard Drive w/RLL Controller	359.00
SEAGATE ST-4038 30Mb Hi-Speed Hard Disk for AT	515.00
SEAGATE ST-251 40Mb Hi-Speed Hard Disk - Half Height	440.00
FUJI 30Mb Hard Drive 3.5" Light Weight w/Mounting	290.00
Monochrome Graphic Card (Hi-Speed) w/Printer Port	65.00
RGB Color Graphic Card w/Printer Port	65.00
EGA Color Graphic Card w/256K RAM/Printer Port	160.00
ATI EGA Wonder Card	220.00
SAMSUNG TTL Mono Amber 12" Monitor - 12SS	80.00
SAMSUNG TTL Mono Amber 12" Flat Screen Monitor	95.00
MISUBA 14" Flat Screen Mono Monitor w/Base	120.00
SAMSUNG 14" RGB Color Monitor - CD-1464W	250.00
SAMSUNG 14" EGA Color Monitor	360.00
TAXAN 12" EGA Color Monitor (640x400) - TX-660	380.00
NEC Multisync EGA 14" Hi-Res Color Monitor	550.00
Copy II PC Option Board (Copies all prot. software)	85.00
LOGITECH C7+ Mouse w/Software (3 Buttons)	79.00
4 Serial Ports Card for AT (Com 1 to Com 8)	125.00
4 Serial Ports Card for XT (Com 1 to Com 8)	85.00
EPSON Printer FX-86E 240cps Dot Matrix 80 Col. NLQ	360.00
EPSON Printer FX-286E 240cps Dot Mat 132 Col. NLQ	495.00
EPSON Printer LQ-1000 180cps 24 Pin NLQ 132 Col.	670.00
OKIDATA Printer ML182 120cps 80 Col Dot Mat NLQ	245.00
OKIDATA Printer ML192 200cps 80 Col. Dot Mat NLQ	366.00
OKIDATA Printer ML193 200cps 132 Col Dot Mat NLQ	529.00
CITIZEN Printer 120D 120cps 80 Col. Dot Matrix NLQ	185.00
Internal Modem 300/1200 Baud w/LED Panel (Misuba)	85.00
External Modem 300/1200 Baud w/LED Panel (Misuba)	95.00

★ NEW ITEM ★ MINI VIDEO/AUDIO TRANSMITTER

Transmits Video/Audio signal from your computer, VCR or camera to a TV set (Ch 15 UHF) as far as 150 feet away. You can watch the same video tape from different TV set in different room or use your TV set as a remote monitor for your computer. AC adaptor included.

Only..... **$49.95**

PINE COMPUTER INC.

9690 TELSTAR AVENUE, EL MONTE, CA 91731
STORE HOURS: MON - SAT 9:00 AM - 6:00 PM
PHONE ORDERS WELCOME: **(818) 575-1882**

VISA
MasterCard

TERMS: VISA or Mastercard accepted. COD order on Cashiers Check only. Check shipping charges when ordering. 3% surcharge for all credit card purchases.

Circle 216

TELEX: 5106017376 PINECOM

Circle 82 on Reader Service Card

DISK-KING®

COLOR DISK - 3M or BASF

WHY RISK THE UNKNOWN...when you can get premium quality disks from the Leader and Inventor of magnetic media....**for less!!**

★100% tested & certified at 65% or higher clipping level★

★ 10 mil sturdy jacket ★ LIFETIME WARRANTY ★

5.25" Diskettes:	Color Disk	3M/BASF
DS-DD-48 TPI Bulk	.48	.54/.43
DS-DD-48 TPI Boxed	.55	.61/.50
DS-HD-96 TPI-Bulk	1.08	1.05
DS-HD-96 TPI-Boxed	1.15	1.12
3.5" Diskettes:		
DS-135 TPI Bulk	1.49	1.20
DS-135 TPI Boxed	1.59	1.29

All 5.25" diskettes are supplied with Tyvek© sleeves, color-coded ID labels, w/p tabs. **Color Disks in Rainbow Assortment.**

DISKCOTECH® presents DISKCOTECHnicolor®

- Warranteed Forever
- 100% tested & certified
- Clipping level-75%
- Exceeds ANSI Specs
- 14 color options
- Tyvek© & labels

DS-DD-48 TPI 5.25"		DS-HD-96 TPI
.69	COLOR BULK	1.59
.84	Plastic Library Box Color	1.74
3.25" DS/135 TPI, **12 Colors** Plastic Library Box		1.69

3M FREE SCOTCH!!

*bonus product & rebate inside while supplies last.

DS-DD	5.25"	DS-HD
.81		1.65
1.63	3.50"	4.80

SS-DD-RH	3M's Highland Diskettes	DS-DD-RH
.49	5.25" 10/bx Tyvek, labels, wp/tabs	.50

DC-1000	12.75	DC-300XL/P	18.95
DC-2000	17.25	DC-600A	21.65
3M **Headcln Kit** for 5.25"	6.99	for 3.5"	10.99
3M **Mag. Tape 2400'**			12.40
3M **Mag. Tape 1200'**			9.40
3M **8"** DS-DD	2.06	3M **8"** SS-DD	1.89

BASF *FREE! Color-Coded Modular Flexy Files a $19.95 value!

5.25" DS-DD in ***Minidex/60**	.83
3.50" DS-DD in **Microdex/25**	1.49
5.25" DS-DD in **Plastic Library**	.81
3.50" DS/DD in **Plastic Library Box/10**	1.45

Nashua DISKETTES BULK 5.25" DS/DD

5.25" DS-DD	.53
5.25" DS-HD-AT	1.39
5.25" DS-DD96TPI	1.29
3.50" DS-DD	1.39

- 100% Certified Error Free
- Exceeds ANSI Specs
- Lifetime Warranty
- USA Made

29¢ + 6¢ for Tyvek© & labels

RIBBONS		STORAGE	
EpsonMX/RX/FX70/80/85	2.89	3M Discover 50	7.95
Epson MX/RX/FX 100/185	3.75	3M D/Defender070 w/key	14.95
Epson LQ1000	3.99	3M Data Defender050	14.99
Epson LQ1500	3.99	SRW Minidex/60	9.95
Okidata Twin Spool	1.19	SRW Microdex/25	9.50
Okidata 182/192/193	3.45	Plastic Library Case	1.50
Apple Imagewriter	2.75	Micro Library Case	1.75
IBM Proprinter	3.99	**ACCESSORIES**	500 1000
Brother HR 15/25 M/S	4.45	Tyvek© envelopes	.055 .039
Panasonic KXP	4.99	Color-Coded ID label	.035 .019
NEC 3500 M/S	4.05		

TERMS: No surcharge on VISA, Mastercard or AMEX. COD add $3.00, Prepaid deduct 2% cash discount, POs accepted from recognized institutions. **Shipping:** $4/100 or fewer disks. Reduced shipping on larger quantities.

TELEX - 9102404712

1-800-523-9681 TOLL FREE 1-801-572-3589

DISKCOTECH

DISKCO TECHNOLOGIES, INC.

P.O. Box 1339 Sandy, Utah 84092

2400 baud

300 1200 2400 MODEM **$160**

XT/AT, Apple, Atari, Commodore & .....

*Fully Hayes compatible

*Auto dial, auto answer, w 8 LED, speaker, Aluminum case

(SAME AS ABOVE)

300 1200 ..... **$99**

300 1200 for XT AT INTERNAL MODEM **$69**

*Add 7% shipping. **10 days money back guarantee** (less $15 ea for restocking & shipping charge)

FOSTER TECHNOLOGY:
*#4, 222 H St., Blaine, **WA** 98230
Phone: (206) 332-5081
*Phone: (604) 684-2368 **CANADA**
(Add 16% for Canadian Orders)

Circle 104 on Reader Service Card

CHAS

MICROSYSTEMS, INC.

103 Route 46 West
Fairfield, NJ 07006
(201) 227-1565
orders only
1-800-543-CHAS
TELEX 6503141175

8088 Turbo Computer

• 4.77/10 MHz • 640K • AT Style Keyboard • 2 360K disk drives • 2 Parallel • Serial • Game • Clock & Calendar w/battery • Mono graphics card • Amber monitor • MS DOS 3.2/GW Basic • 1 YEAR WARRANTY $820.00 ($999.00 with 20 meg hard disk drive and 1 floppy)

286 Turbo Computer

6/10 MHz • 640K • Enhanced keyboard • 1.2 MB FD • 360K FD • 2 Parallel • Serial • Game • Clock & Calendar w/battery • Mono graphics card • Amber monitor • MS DOS 3.2/GW Basic • 1 YR. WARRANTY • $1110 ($1499 w/40 meg hi-speed HD w/1.2 meg floppy)

** **Color and EGA Systems Available** **

• 20 MB HD Kit $289 • 30 MB HD Kit $309 •
• Hayes compatible modems start at $77 •
Printers start at $199

WE CAN CUSTOM CONFIGURE ANY SYSTEM!
CALL FOR PRICE LIST! DEALER INQUIRIES WELCOMED!
(prices subject to change without notice)

Circle 48 on Reader Service Card

controls up to 4 motors from any CRT, terminal or computer

Now With **STEPPING MOTOR CONTROLLER**

Microstepping & Circular Moves

• RS232 interface • Accel/Decel

BASIC Version	$985
16K BASIC, Battery Backup	$1335
CNC Version	$2910
Stepping Motor Tips Cookbook	$8

CALL OR WRITE
CENTROID (814) 237-4535
Box 739, State College, PA 16804

Circle 47 on Reader Service Card

P-tral BASIC to Pascal **$179**

TRANSLATOR

Translate your BASIC source programs to Pascal source. P-tral, now available for the IBM PC and compatibles, will translate MS–BASIC/BASICA to Turbo Pascal
(Req Dos 2.0 or later w/ANSI.SYS).

Also available for the Apple II series (incl. IIGS) and converts Applesoft to Apple Pascal.

(212) 206-6490 / 924-0576
WOODCHUCK INDUSTRIES
340 WEST 17TH STREET (#2B)
NEW YORK, NY 10011

Circle 298 on Reader Service Card

"D" SIZE PLOTTER

$1595.00

$2295.00 RETAIL

Model PC 3600

- Repeat ability .001 inches
- Vacuum paper hold down
- Speed 7 inches per second

(415) 490-8380
ZERICON

4423 Enterprise Street
Fremont, CA 94538

NEWS RELEASE

Circle 303 on Reader Service Card

Sure it's insured?

SAFEWARE® Insurance provides full replacement of hardware, media and purchased software. As little as $39/yr. covers:

• Fire • Theft • Power Surges
• Earthquake • Water Damage • Auto Accident

For information or immediate coverage call:

1-800-848-3469

In Ohio call 1-614-262-0559

SAFEWARE

SAFEWARE, *The Insurance Agency Inc.*

Circle 237 on Reader Service Card

TIMELINE INC.

ORDER DESK ONLY

Continental U.S.A. (800) 872-8878 | Inside California (800) 223-9977 | L.A. & Technical Info (213) 217-8912 | OEM INQUIRIES WELCOME

INCREDIBLE PRICE BLOWOUT!

SEIKO 8650

FULL HEIGHT HARD DISK DRIVE

WOW! **$75.00**

10 Mb Unformatted
8.2 Mb Formatted
75 ms average access time

WITH WESTERN DIGITAL ½ CARD **$149.00**

WITH RLL CARD (ADAPTEC) **$179.00**

FOUR PEN COLOR PLOTTER

*** $159.00 ***

— $500.00 value —

Ideal for architectural applications, CAD and graphic design. This color plotter will connect to the serial port of most microcomputers. The four color pens draw various shapes using ASCII commands. Enlarging and reducing is possible. Can run Generic CAD and PCAD. (Software drivers available for Autocad.) Uses 11″ x 17″ paper.

ACCESSORY KIT **$25.00**

NEC UPD791D

(CHARGE COUPLED DEVICE)
4096 ELEMENT

"Spy In the Sky"

LINEAR IMAGE SENSOR

$39.95

★ Designed for page scanning applications including facsimile. Optical Character recognition and other imaging applications which require high resolution and high sensitivity. ★

With DRIVER BOARD **$99.00**

HITACHI

511-1
42 Mb Formatted
33 ms average access
$449.00

WANGTEK

60 MB Tape Backup
FULL HEIGHT
MODEL 5099EG24
$249.00

ATASI

3046
39 Mb Formatted
33 ms average access
$399.00

SEAGATE

20 Mb Hard Drive Kit . . . **$325.00**

30 Mb Hard Drive Kit . . . **$375.00**

★ ★ ★ FABULOUS DEALS! ★ ★ ★

REMEX

RFD 480
⅔ HT 360K DS/DD
$35.00

QUME

TRACK 142
½ HT DS/DD 5¼″
$65.00

SEIKO

8640
FULL HEIGHT
640K DS/DD
(Reads & writes 360K disks)
$35.00

BAR CODE WAND, HEWLETT-PACKARD/HBCS 4300/4500 Sapphire Tipped Industrial Digital Hand held scanner. Reads all common bar code formats.

$69.00

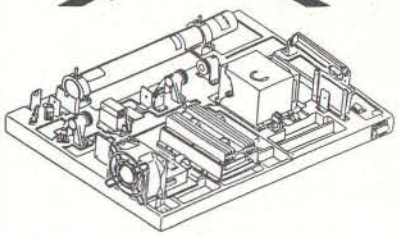
ZENITH — Green screen composite monitor (able to switch from 40 to 80 column and back) **$59.95**

PC/XT KEYBOARDS **$39.95**

LASER ARRAY

ORIG. COST

~~$5,000.00~~



LIQUIDATION PRICE

$499

INCLUDES

1. **LASER - (10 milliwatt)**
2. **LASER Power Supply**
3. **MIRRORS (5)**
4. **LENSES (3)**
5. **BEAM SPLITTERS (2)**
6. **POLYGON MOTOR, LENS & DRIVER**
7. **A-O MODULATOR**
   A-O DRIVER
8. **LASER BRACKETS (2)**
9. **SENSOR (2)**

ITEMS MAY BE PURCHASED SEPARATELY
QUANTITIES LIMITED

CALL FOR FREE INFORMATION ABOUT THIS AMAZING LASER DECK

TIMELINE

1490 W. ARTESIA BLVD, GARDENA, CA 90247

Inside California (800) 233-9977 | Continental U.S.A. (800) 872-8878 | L.A. Area & Technical Info. (213) 217-8912

15% Restocking fee for returned orders.

Circle 277 on Reader Service Card

VISA MasterCard

Minimum Order: $25.00. Shipping & handling charges via UPS Ground: $.50/lb. UPS Air: $1.00/lb. **Minimum Charge: $4.00.** We accept cashiers checks, MC or VISA. No personal check COD's. Items reflect 5% cash or check discount. California residents add 6½% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. **Foreign Orders require special handling. Prices subject to change without notice.**

1. System requirements:
★ IBM/PC/XT/AT or compatible
★ 256K RAM
★ DOS 2.0 or higher

2. EPROMS:
2732A
8764
2764
2764A
27128
27128A
27256
67256
27512
27513
27011
AND THEIR CMOS VERSIONS
PROGRAMMING ALGORITHM
INTELLIGENT PROGRAMMING

PRO — 1
The PROFESSIONAL PROGRAMMER
Technical Data

3. FUNCTIONS:
BLANK CHECK
EDIT—FULL SCREEN EDITOR
FILL RAM with FIXED DATA
GO TO address in RAM
MOVE data blocks in RAM
COMPARE—DISPLAY DIFFERENCE
VERIFY
READ EPROM into RAM
SEARCH STRING
WRITE—Store RAM into file
LOAD file into RAM
PROGRAM

4. BLANK CHECK and BIT ERROR CHECK before programming. VERIFY + CHECKSUM after programming.

5. FORMATS:
INTEL HEX
MOTOROLA HEX
BINARY

6. Split of large files into small sub-files enables programming large programs in small EPROMS.

7. Handling either 8 bit or 16 bit DATA

$130.00

ADCOM
DESIGN AND MARKETING OF COMPUTERS AND COMMUNICATIONS SYSTEMS
DISTRIBUTOR:
MARLIN, INC.
920 GRAND BLVD.
DEER PARK, N.Y. 11729
800-222-8887

Circle 5 on Reader Service Card

CONVERT *YOUR* PARALLEL PRINTER TO SERIAL NOW!

B&B's NEW
Model 232SPC "RS-232 Serial to Parallel CONVERTER"

B&B's NEW serial to parallel converter increases the utility of your parallel printer by converting it to serial. A fine product designed by B&B to meet the needs of parallel only printer owners. Complete with AC power supply. Can be programmed for 150 to 9600 Baud, Parity, 7 or 8 Bits, number of Stop Bits, and Busy output on pin 4 or pin 20. A TERRIFIC PRODUCT.

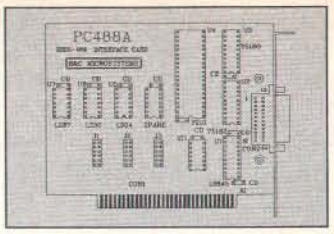
Model 232SPC Serial to Parallel Converter..... **$119.95**
Also available with an IBM® parallel to Centronics® printer type cable. Model 232SPCC Converter with cable..... **$124.95**

BUY DIRECT FROM MANUFACTURER AND SAVE! SAME DAY SHIPMENT!

Write or call for FREE B&B ELECTRONICS MFG. CO. CATALOG TODAY! Terms: Visa, MC, cash orders postpaid. P.O.'s from rated firms accepted. Illinois residents add 6¼% state sales tax.

B&B electronics
MANUFACTURING COMPANY
1502K Boyce Memorial Drive • P.O. Box 1040
Ottawa, IL 61350 **815-434-0846**

Circle 38 on Reader Service Card



PC488 $195

LOW COST PC/XT/AT INTERFACE FOR IEEE-488 (GPIP/HPIB)

- SHORT CARD FOR PC/AT/XT & COMPATIBLES
- 1 OF 6 INTERRUPT LEVELS
- 1 OF 2 DMA CHANNELS
- UP TO 4 BOARDS / COMPUTER
- CONTROLLER / TALKER / LISTENER
- QUANTITY DISCOUNTS
- COMPATIBLE WITH MOST SOFTWARE PACKAGES

B&C MICROSYSTEMS
355 West Olive Ave, Sunnyvale, CA 94086
Phone (408) 730-5511 Visa & MC

Circle 41 on Reader Service Card

Serial ◀▮▮▮▮▮▮▮▮▶ Parallel

NEW!

Convert What You Have To What You Want!

* RS232 Serial
* 8 Baud Rates
* Latched Outputs
* Centronics Parallel
* Handshake Signals
* Compact 3½ × 4¾ × 1⅛

No longer will your peripheral choices be limited by the type of port you have available! Our new High Performance 700 Series Converters provide the missing link. Based on the latest in CMOS technology, these units feature full baud rate selection to 19.2K, with handshake signals to maximize transfer efficiency. Detailed documentation allows simplified installation. Order the Model 770 (Ser/Par) or Model 775 (Par/Ser) Today!

WE'VE MOVED!!

TigerTronics INCORPORATED
400 Daily Lane
P.O. Box 5210
Grants Pass, OR 97527

only **$89.95**
Connector Option $10.00
CA Residents 6% tax
UPS Shipping $3.00

Call (503) 474-6700 or 474-6701
For FAST Delivery

Circle 276 on Reader Service Card

PC-AT TURBO COMPLETE SYSTEM **$1399.00**
640K RAM/1.2MB floppy drive/30MB hard drive HDD-FDD controller/Monochrome card/Monochrome monitor/200W powersupply/AT keyboard/Phoenix BIOS.

PC-XT TURBO COMPLETE SYSTEM **$659.00**
640K RAM/2 floppy drives/Monochrome monitor/Monochrome card/150W powersupply/AT style keyboard/Phoenix Bios.

PC-XT TURBO W/20MB HARD DRIVE **$927.00**
640K RAM/1 floppy drive/Monochrome monitor/Monochrome card/150W power supply/AT style keyboard/Pheonix Bios.

FREE SOFTWARE WITH PURCHASE OF ANY SYSTEM

ORDERS
Nationwide Toll Free 1-800-331-0488
Inquiries/Support Fl. only 1-305-296-6083

Sai Systems Laboratories, Inc.
103 Fitzpatrick Street
Key West, Fla. 33040

Circle 238 on Reader Service Card

PAL/EPROM PROGRAMMER CARD
For PC/XT/AT Systems

NEW -- VERSION 2 OF SOFTWARE AND HARDWARE

-Programs 20 and 24 Pin MMI, NS, TI, AMD, ALTERA, CYPRESS, RICOH, and PANATEC PALS. Supports EPLD, polarity, RA, and shared product term types.
-Functions Include: Read, Write, Verify, Protect, Edit, Print, and File load and save of program.
-JEDEC supported.
-Software Included

$475

100MHZ LOGIC ANALYZER CARD
For PC/XT/AT Systems

$1199

-24 Channels at 25Khz-25Mhz
-6 Channels at 100 Mhz
-Internal Clock up to 100 Mhz
-External Clock up to 25 Mhz
-Threshold Voltage TTL, ECL, or variable from -10 to +10v
-Can Stack Multiple Boards
-All Software Included

CALL NOW FOR ORDERS AND TECHNICAL INFO (201) 994-6669

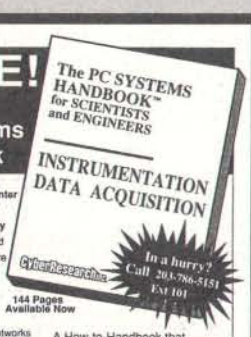
Link Computer Graphics, Inc. 4 Sparrow Dr., Livingston, NJ 07039. TLX: 9102409305 LINK COMPUTER

Circle 151 on Reader Service Card

FREE!
Turn-key PC Systems Handbook

NEW 1988 Fall/Winter Edition

Save Time and Money
Over 1000 Hard-to-find Hardware and Software Items of Special Interest to Technical PC Users:



144 Pages Available Now

- RS 232/IEEE 488 Networks
- Stepping & Servo Motor Controls
- Ruggedized PC's
- Rack Mtg. 80286 & 80386
- Laboratory Automation
- 1 MHZ A/D
- Digital Scopes to 200 MHZ
- High Speed Bus Adapters
- Waveform Synthesizers
- Data Loggers
- PC Bus Expansion Chassis
- And Much More

A How-to-Handbook that enables you to configure the BEST products from the world's leading PC hardware and software vendors into risk free turn-key system solutions that meet your needs.

Toll Free Hotline for application assistance and convenient one stop shopping at competitive prices. 100% Satisfaction Guaranteed.

Call or write for a FREE handbook today!
203-786-5151 Ext. 101
(9:00 AM to 5:00 PM E.S.T)

CyberResearch Inc.
P.O.Box 9565, New Haven, CT 06536
Fax: 203-786-5023 Telex: 9102501037

Circle 74 on Reader Service Card

NOW, AN EASY WAY TO SHARE YOUR PRINTER!

Share any number of PC's and printers without cables, switches, or waiting.

Just plug PAMCO's Lil' Devil into the printer port of your PC. Works like a printer buffer and saves the data on a removable RAM cartridge. At your convenience, plug the RAM cartridge into another Lil' Devil attached to your shared printer. Easy!

Allows you to work anywhere. Frees your PC and Printer. Even a floppy disk can't do all that PAMCO's Lil' Devil can.

Comes complete with power supply, standard parallel printer port recepticle, standard parallel printer cable and plug, one RAM cartridge and instructions for only $149.95.

Call for more information **1-800-255-6265**
N.C. 704/529-1593

PAMCO
920 Blairhill Rd., Suite 101
Charlotte, NC 28217

Circle 314 on Reader Service Card

ENHANCED
VT220 $150

Zstem by KEA

The most complete VT220 emulation available for your PC/XT/AT or compatible.
- HIGH PERFORMANCE to 38.4K BAUD
- TRUE DOUBLE HIGH/DOUBLE WIDE
- TRUE 132 COLUMN MODE ON MOST EGA'S
- COLOR EXTENSIONS/DOWNLOADABLE FONTS
- SOFTKEY/MACROS, DOS ACCESS
- XMODEM/KERMIT FILE TRANSFERS

plus many more extensions!

ZSTEMpc™-VT220 Emulator **$150.**
with PowerStation™220 layout keyboard **$289**
'EGAmate™ option for true EGA 132 column **$39**
ZSTEMpc™ - 4014 option **$99**

KEA Systems Ltd.
#412 - 2150 West Broadway
Vancouver, B.C. Canada V6K 4L9
Support (604) 732-7411
TELEX 04-352848 VCR **FAX** (604) 732-0715
Order Toll Free (800) 663-8702
30 day money back guarantee. MC/VISA

Circle 144 on Reader Service Card

BEST SELECTION OF SOFTWARE TOOLS.

Solving your scientific and engineering problems just got simpler.

Science & Engineering Software Co. is the only source with all the software you need to solve your specialized problems: Statistical data analysis, circuit design, data acquisition and signal analysis, solving complex equations, 3D CAD/CAM design, high-tech graphics, technical word processing and more. Whether you're writing your own program or looking for a specific application, our experts can help you choose the best programs for your needs.

Call today and get our solutions working for you.

- No one offers you more variety.
- If you don't see a title, we'll special order it.
- If you don't know the publisher, we'll find it.
- Over 300 programs available.
- We offer a 30-day, money-back guarantee.*

CIRCUIT DESIGN

ECA-2, Tatum Labs	$ 629
HiWire, Wintek Corp.	849
MICRO-CAP II, Spectrum Software	759
PADS PCB, CAD Software	925
w/PADS-Route	1,639
smARTWORK, Wintek Corp.	849
TangoPCB, ACCEL Tech.	495
Tango Route, ACCEL Tech.	495

DATA ACQUISITION/SIGNAL ANALYSIS

Asyst 2.0, Macmillan Software	$2,179
Asyst Modules 1,2,3	1,989
Asyst Modules 1,2,4	1,989
Asyst Modules 1,2	1,609
ASYSTANT, Macmillan	469
ASYSTANT+, Macmillan	849
DADiSP, DSP Systems	750
Fourier PERSPECTIVE II, Alligator Transform	329
ILS-PC1, Signal Tech.	995
ILS-PC2, Signal Tech.	1,495
LabTrac II, Laboratory Microsystems	CALL
LabTrac Plus	CALL
LMS Mech. Test. Pkg., Laboratory Microsystems	CALL
LMS Thermal Analysys	CALL
LMS Capillary Melt Rheometry	CALL
Lotus Measure	445
Metrabyte D.A. & Control Tools, Quinn-Curtis	89
Prime Factor FFT, Alligator Transform	139
QED D.A. and Control, Hart Scientific	799
Snapshot Storage Scope, HEM Data Corp.	495
Snap FFT, HEM Data Corp.	295
Turbo Pascal S&E Tools, Quinn-Curtis	69
UnkelScope Level 2+, Unkel Software	529
UnkelScope Level 1	329
UnkelScope Junior	119

EQUATION SOLVERS

Eureka: The Solver, Borland	$ 69
MathCAD, MathSoft	309
muMATH, Microsoft	185
SolveIT!, Structured Scientific Software	79
TK!Solver Plus, Universal Technical Systems	395

FIRMWARE DEVELOPMENT

GENELINK, Genesis Microsystems	$ 495
GENESCOPE/TARGET, Genesis	1,395
LINK & LOCATE, Systems & Software	329
ROMpac, Computer Innov.	219
PC LOCATE, Aldia Systems	229
SOFTPROBE II/TX, Systems & Software	695

GRAPHICS/CAD

AutoESL, Systems Unlimited of California	$ 279
AutoSHAPES, Systems Unlim.	189
Boeing Graphs	279
CADKEY, Micro Control Sys.	2,559
Drafix Plus, Foresight	CALL
EASY CAD, Evolution Computing	139
FAST CAD, Evolution Comp.	1,849
FSIMPLEX, Systems Unlim.	89
Generic CADD	89
HALOVISION A, Media Cybernetics	399
HALOVISION D	399
HALOVISION I	399
HYPERPLOT, JHM Int'l.	239
In°A°vision, Micrografx	459
PC MAP II, Peerless Engineering Service	949
PERSPECTIVE, Three|D| Graphics	229
ProDesign II, American Small Bus. Computers	219
TECH°GRAPH°PAD, binary engineering	259
3D CAD, CAD Soft.	315
Turbo View, Sublogic Corp.	449
Windows Clip Art, Micrografx	79
Windows Convert, Micrografx	79

SCIENTIFIC TEXT PROCESSING

CHEM-TEXT, Molecular Design Ltd.	$1,500
For Math, Shantha Software	379
Lotus Manuscript	445
PC TEX, Personal TEX	229
T³ Scientific Word Proc. Sys., TCI Software Res.	499
T³ Graphics Font Sets	89
T³ Laser Printer Support	79

STATISTICS

Microstat, Ecosoft	$ 319
NWA Quality Analyst, Northwest Analytical	419
NWA STATPAK, Northwest	419
SYSTAT	499
LARGE 512K Version	CALL
Report Writer	CALL
Econometrics	CALL
Test Scoring & Analysis	CALL
File Transfer	CALL

ADDITIONAL S&E PRODUCTS

Engineer's Aide, Engineering Programming Concepts	$ 649
LABTECH Notebook, Laboratory Tech. Corp.	759
LABTECH Real Time Access	269
LABTECH CHROM	709
PC-Matlab, The Math Works	659
POINT FIVE, Pacific Crest	279
The System Identification Toolbox, The Math Works	279

APL LANGUAGE

APL°PLUS/PC, STSC	$ 439
APL°PLUS/PC Spreadsheet Mgr.	145
APL°PLUS/PC Tools Vol 1	199
APL°PLUS/PC Tools Vol 2	65
ATLAS°GRAPHICS, STSC	339
Financial/Statistical Library, STSC	199
Pocket APL, STSC	79
SCREEN ACE, ACE Software	165
STATGRAPHICS, STSC	599

BASIC LANGUAGE

BetterBASIC, Summit	$ 139
BetterBASIC Add-ons	CALL
87 Software Pak, Hauppauge	149
EXIM Services Toolkit	45
Finally, Komputerwerks	89
Inside Track, MicroHelp	55
MACH 2, MicroHelp	59
MicroHelp Utilities	49
Microsoft QuickBASIC	69
Peeks 'n Pokes, MicroHelp	39
Professional BASIC, Morgan	75
8087 Math Support	45
Quick-Tools, BC Associates	109
QuickPak, Crescent Software	59
Scientific Subroutine Library, Peerless	99
Screen Sculptor, Software Bottling	95
Stay-Res, MicroHelp	75
True Basic w/Run-Time	179
True Basic	105
Turbo BASIC, Borland	65

C COMPILERS

Lattice C	$ 275
Microsoft C	269
Quick C, Microsoft	69
Turbo C, Borland	65

C UTILITIES/LIBRARIES

ADVANTAGE Graphics, Lifeboat	$ 235
Asynch Manager, Blaise	135
CxPERT, Software Plus	249
C Tools Plus, Blaise	135
C Utility Library, Essential Software	129
Essential Comm Library	139
Essential Graphics	195
Greenleaf Functions	129
Greenleaf Comm	129
Greenleaf Data Windows w/Source	159 299
PforCe, Phoenix	225
Pre-C, Phoenix	159
QuickScreen, Lifeboat	179
TimeSlicer, Lifeboat	275
w/Source	CALL
Vitamin C, Creative Programming	169
VC Screen	85
Windows for C, Vermont Creative	199
Windows for Data, Vermont Creative	319

FORTRAN LANGUAGE

ACS Time Series, Alpha Computer Service	$ 395
DIFF-EQ, Microcompatible	445
87 SFL, Microway	239
Essential Graphics	195
For-Winds, Alpha Computer	75
Forlib-Plus, Alpha Computer	59
FORTLIB, Sutrasoft	119
FORTRAN Addendum, Impulse Engr.	89
FORTRAN Addenda, Impulse	149
GRAFLIB, Sutrasoft	169
HALO, Media Cybernetics	215
I/O PRO, MEF Environmental	139
Grafmatic/Plotmatic, Microcompatibles	119
Lahey FORTRAN	CALL
Lahey Personal FORTRAN	89
Math Pac, Systolic Systems	445
Meta Window, Metagraphics	169
Meta Window Plus	239
Microsoft FORTRAN w/CodeView	279
No Limit, MEF Environmental	119
PANEL, Lifeboat	215
PANEL Plus, Lifeboat	409
PLOTHI, Sutrasoft	169
PLOTHP, Sutrasoft	169
RM/FORTRAN, Ryan-McFarland	409
RM/Screens, Ryan-McFarland	339
RTC PLUS, Cobalt Blue	299
Source Print, Aldebaran	85
SSP/PC, Lattice	279
Statistician, Alpha Computer	245
Strings & Things, Alpha	55

GAUSS

GAUSS Programming Language, Aptech Systems	$ 189
GAUSS Math & Stat Modules, Aptech Systems	45
GAUSS Math & Stat System	339

PASCAL COMPILERS

Microsoft Pascal	$ 189
Pascal-2, Oregon Software	329
Turbo Pascal, Borland	69

TURBO PASCAL ADD-ONS

DOS/BIOS & Mouse Tools, Quinn-Curtis	$ 69
FirsTime, Spruce Technology	65
Flash-up, Software Bottling	79
Flash-up toolkit	45
Inside Track, MicroHelp	55
MACH 2, MicroHelp	59
Metrabyte D.A. Tools, Quinn-Curtis	89
Peeks 'n Pokes, MicroHelp	39
Report Builder, Royal American	75
S&E Tools, Quinn-Curtis	69
Screenplay, Flexus	89
Speed Screen, Software Bottling	35
System Builder, Royal American	119
Turbo Numerical Methods, Borland	69
TP2C, BISS of Louisiana	215
TURBO-ASM, BCSoft	85
Tdebug Plus, TurboPower Software	49
Turbo ASYNCH PLUS, Blaise	79
Turbo Database Toolbox, Borland	49
Turbo Editor Toolbox, Borland	49
TurboEXTENDER, TurboPower Software	69
Turbo Graphix Toolbox, Borland	49
Turbo Magic, Sophisticated Software	69
Turbo Master, Hawaiian Village Software	99
Turbo Optimizer, TurboPower	69
w/Source	115
Turbo POWER TOOLS PLUS, Blaise	79
Turbo Professional, Sunny Hill Software	49
TurboHalo, IMSI	99
TurboPower Utilities, TurboPower	79

OBJECT-ORIENTED LANGUAGES

Actor, White Water Group	CALL
ADVANTAGE C++, Lifeboat	$ 479
PforCe++ Library, Phoenix	225
SmallTalk V, Digitalk	85

CROSS TOOLS

CASM-6502 C X-COMPILER, RELMS	$1,299
CASM-80 C X-COMPILER, RELMS	1,299
CASM-Z80 C X-COMPILER, RELMS	1,299
Lattice 68000 C X-COMPILER	439
Lattice Z80 C X-COMPILER	439
MICROTEC MCC68K C X-COMPILER	CALL
MICROTEC X-ASM	CALL
PASM-68K PASCAL X-COMPILER, RELMS	1,489
PASM-80 PASCAL X-COMPILER, RELMS	1,299
PASM-Z80 PASACAL X-COMPILER, RELMS	1,299
Quelo 68000/68010 X-ASSEMBLER	509
RELMS X-ASMS	CALL
Uniware 8-bit X-ASMS, SDS	265
Uniware 16/32-bit X-ASMS	355
Uniware C68020 C X-COMPILER	895

DISK/DOS/KEYBOARD UTILITIES

Norton Utilities	$ 59
Advanced Norton Utilities	109
Keyworks 3.0, ALPHA SOFTWARE	89
Keyworks Advanced	269
Quaid Analyzer	99
Bookmark, Intellisoft	79
PDisk, Phoenix	89
ADVANTAGE Disassembler, Lifeboat	275
Command Plus, ESP Software	69
FANSI-CONSOLE, Hersey Micro	65
Intelligent Backup, Sterling Software	135
Norton Commander	55
OPAL, Software Factory	89
OPART	69
Q-DOS II, Gazelle Systems	59
Scroll & Recall, Opt-Tech Data	59
Taskview, Sunny Hill Software	55
Back-It, Gazelle Systems	89
Disk Optimizer, Softlogic Systems	55
FASTBACK, 5th Generation Sys.	135
XenoCopy-PC, XenoSoft	69

Ordering Information

We accept AMERICAN EXPRESS, MC, VISA and PERSONAL CHECKS. There is no surcharge on credit card or C.O.D. New York State residents must add sales tax. Shipping and handling $3 per item. Rush service is available.

- International orders add $10 for export preparation.
- Prices and policies may change without notice.
- Corporate Buyers call for special rates.

*Ask for details before you buy; some manufacturers won't take returns if disk seals are broken.

In the U.S. CALL

1-800-333-3141

International Orders

914-332-0756

Science & Engineering

SOFTWARE CO.

55 South Broadway, Tarrytown, NY 10591

SAVE ON

9 TRACK TAPE SYSTEM

FOR IBM PC/XT/AT

- Mainframe to PC Data Transfer
- High Speed Backup
- All Software, Complete System
- Service and Support, easy Installation

call **(818) 343-6505** or write to:
Contech Computer Corp.
P.O. Box 153 Tarzana, Calif. 91356

CONTECH

Circle 68 on Reader Service Card

Motion Control & Data Acquisition

on your IBM PC or Apple II and all compatibles

Smart 2 Axis Motion Controller: For many types of motors & encoders. New I.C. (from HP) allows changes & monitoring on the fly. Optically isolated. W/SOFTWARE $400.
Four Axis Stepper Driver: With SOFTWARE & motor for instant automation. $95.
Fast A/D Board: With programmed gain, 650 KHz, 4 inputs, $220. Complete Scope hardware & SOFTWARE $500. **Also:** 12 Bit A/D, Relay Driver, Real Time Clock. Circuit developers Project Book $25.

How do you do it? Use our Local Applications Bus, **LAB 40.** One host adapter ($150) supports up to 8 boards, like those above, on a 50 ft. ribbon cable.

Please call (415) 755-1978 for free literature.

Computer Continuum
75 Southgate Ave., Suite 6
Daly City, CA 94015 (415) 755-1978

Circle 29 on Reader Service Card

NEW

FLOPPY CLOCK™

SPECIAL INTRODUCTORY OFFER

Precision quartz movement. Genuine 5¼" floppy diskette face. Clear floppy diskette storage case—opens for desktop display (lid becomes accessory tray), and closes for wall mount. 1-year warranty. Grid styles available in BLUE, GRAY, or BLACK.

Send: Cash/Check/MO to BEARE ENTERPRISE 1480 RT. 46 SUITE 53-B / PARSIPPANY, NJ 07054 (201) 334-7491 / NJ Res. add 6% sales tax.
Accessories & 'AA' bat. not incl.

Presto!
A Link to Mainframe Graphics

Find out how our whole family of EMU-TEK graphics terminal emulation software makes good sense for the work you do. Call today for more information.

FTG DATA SYSTEMS

(714) 995-3900
(800) 962-3900 (800) 972-3900 (Calif.)
10801 Dale St., Suite M-2
Stanton, CA 90680

Circle 108 on Reader Service Card

Beat the limits!

Vfeature™ DELUXE

Software for hard disks

- DOS partitions to 1 GIGABYTE
- Spans two drives in one bootable partition
- Supports big drives on AT and XT
- Secures data

GOLDEN BOW SYSTEMS

$120
$3 shipping/ handling
California orders add 6%

2870 Fifth Avenue
Suite 201
San Diego, CA 92103
619/298-9349

Circle 113 on Reader Service Card

Get the whole story on graphics terminal emulation.

To find out more about software that lets your PC emulate TEKTRONIX™ 4105/6/7/9 and DEC VT100™ terminals, call or write:

GRAFPOINT
4340 Stevens Creeks Blvd., Suite 280, San Jose, CA 95129 (408) 249-7951

Circle 114 on Reader Service Card

JKL's OCTOBER BARGAINS

JKL AT: 80386 (16 MHz) w/case 200W, P.S., Keyboard **$2195.00**
JKL AT 40: Above plus 40 Meg. HD, 1.2 Floppy, Graphics Card, & Monitor **$3295.00**
JKL AT 80: Above plus 80 Meg. HD, 1.2 Floppy, EGA Card & Monitor **$4495.00**

Cases: AT .... **$74.10** XT **$35.10**
Power Supply: AT 200W **$85.80** XT 150W **$58.50**
Cards:
Monochrome Graphics Card w/Printer Port .. **$50.70**
AT Hard Disk and Floppy Controller Card .. **$161.20**
Hard Disks: AT 40 Meg, 40MS Hard Disk **$492.70**
XT 30 Meg Hard Disk w/Controller **$349.70**

JKL

Jack Krochmal, Ltd.
Computers, Peripherals & Supplies
717 Ellsworth Drive
Silver Spring, MD 20910
(301) 565-2910/587-3232
Toll Free:
1-800-JK3-0386

Circle 141 on Reader Service Card

REAL WORLD I/O

For PC/XT/ATs

AD200 • 4 channel, 12-bit A/D board. 10 kHz sampling rate. Instrumentation amp front end. **$239**

AD500

ADA300 • 8 channel, 8-bit A/D; single D/A; 24 programmable digital I/O lines. **$239**
AD500 • 8 channel, 12-bit A/D board. Software programmable gains of 1,10, and 100. Highly accurate integrating converter. 7 digital I/O lines. High-Z inputs. **$239**
AD100 • Single channel version of AD500. 10 digital I/O lines. Same accuracy and programmable gains. **$149**
DA600 • Fast settling 12-bit dual D/A converter. **$169**
DG24 • Digital I/O board with 24 TTL lines configurable in software. **$95**
XB40 • Easy connect extender/prototype board with terminal strips. **$49**
OEM discounts available.

Real Time Devices, Inc.
rtd 1930 PARK FOREST AVENUE P.O. BOX 906 STATE COLLEGE, PENNSYLVANIA 16804
(814) 234-8087

Circle 234 on Reader Service Card

HARD DISK CONTROLLERS

ADAPTEC

PC-XT Controller ST506/412	$85
2070 PC/XT RLL	$109
3530 SCSI to Tape QIC 36	$99
4000 SCSI to ST506/412	$109
4000A SCSI to ST506/412	$129
4070 SCSI to ST506/412 RLL	$129
4520 SCSI to ESDI	$139
5500 SCSI to ST506/412	$255
5580 SCSI to SMD	$450

OTHERS

Xebec S1410	$109
OMTI 20C, L	$99
DTC 510A	$99
Shugart 1610-1, 3 or 4	$79
W/D 1002-SHD Xebec Compatible	$109

- Call for cable prices.
- Controller manuals $8 each.

Computer Surplus Store "WE BUY AND SELL"
Phone 408-434-1060
FAX 408-434-0931
Telex 1561447

MC/VISA/Discover/COD's (cash or certified check)

Circle 62 on Reader Service Card

PC-XT COMPATIBLE

CAT™ 8MHZ BASE SYSTEM

- 256K (Optional 640K)
- 150 Watt Power Supply
- AT Style Keyboard
- 4.77 or 8 MHZ Keyboard Selectable
- FDC w/360K Floppy
- 8087 Socket

$389.00

4.77 or 8 Mhz

OPTION A	OPTION B	OPTION C
Base System Plus	Base System Plus	Base System Plus
Amber Mono Monitor Graphics Compatible Mono Card Parallel Printer Port	Color RGB Monitor Graphics Compatible Color Card Parallel Printer Port	Amber Mono Monitor Graphics Compatible Mono Card Parallel Printer Port 20Meg Hard Drive
$537.00	$728.00	$829.00

PC-AT COMPATIBLE

CAT™ 286-10 BASE SYSTEM

- 640K (120 NS)
- 200 Watt Power Supply
- AT Style Keyboard
- Western Digital Controller
- Teac 1.2 Meg Floppy
- Legal Bios w/manuals
- Systems Documentation
- 1 Year Waranty

$999.00

6Mhz or 10Mhz

OPTION A	OPTION B	OPTION C
Base System Plus	Base System Plus	Base System Plus
Amber Mono Monitor Graphics Compatible Mono Card Parallel Printer Port	Color RGB Monitor Graphics Compatible Color Card Parallel Printer Port	EGA HiRes Monitor EGA Interface Card Parallel Printer Port
30Meg 40Meg	30Meg 40Meg	30Meg 40Meg
$1585 $1722	$1781 $1931	$2043 $2188

All CAT Systems come with 1 year Parts & Labor Warranty
All CAT Systems are FCC Class B Approved
All CAT Systems have a 30 Day Money Back Compatibility Guarantee

SYSTEM UPGRADES

101 Kbd. Enhancment . 29.00	384K Memory Upgrade 59.00	Extended 2 Year
10Mhz Add 50.00	512K AT Mem. Upgrade 79.00	Warranty 90.00
MSDOS 3.21 ..... 89.00	360K Drive 89.00	IO Card 69.00

Seagate

HARDDRIVE

- ST225 - 20 Meg
- Western Digital Controller
- W/cables & 1 Yr. Warranty

$309.00

EVEREX

TAPE BACKUPS

40Meg $395.00
60Meg w/Controller Software $595.00

Add **150.00** for External

CITIZEN Panasonic

120D or 1080I

- 120CPS
- 80 Col
- Built In Tractors

Laser Jet 1895.00

$189.00

ATASI

3046 HARDDRIVE

- 40Meg
- 33 Mil. Sec.
- Manuals & Rails Incl.

6 Month Warranty

$389.00

Partioning Software **49.00**

CTX MONITOR EGA

- 640 x 350
- 14" Non-Glare Screen
- Green/Amber Text Switch

$399.00

RGB Color Monitor.... $279.00

It's another ZUCKERBOARD

1200Z MODEM

- Half Card
- Auto Switch 300 or 1200
- Hayes Compatible
- PC Talk III Software

$79.00

TOSHIBA

3½ DISK DRIVE

- 720K
- W/Mounting

$129.00

Requires DOS 3.21... **89.00**

150 WATT POWER SUPPLY

- IBM Direct Replacement
- UL Approved

$59.00

intel

CO PROCESSORS

8087-3 5Mhz	109.00
8087-2 8Mhz	149.00
80287-6 6Mhz	189.00
80287-8 8Mhz	249.00
80287-10 10Mhz	299.00
80387	499.00

CALL for Above Board Pricing

Micro Accounting Software Liquidation

- General Ledger
- Accts. Receivable
- Accts. Payable
- Check Register

LIST PRICE 695.00 **$195.00**

Toll Free Tech Line Support

EVEREX

MODEM (Hayes Comp.)

EV 1200 Baud Int ...	$89.00
2400	199.00
2400 External	259.00

Above Boards

AT Expanded Memory ... 119.00
0 - 2 Meg

Seagate

HARDDRIVES

30Meg ST238 w/wd Cont. **349.00**

40Meg ST251 w/Software ... **449.00**

ALL TRADEMARKS ARE REGISTERED with their respective companies

800-654-7762
SALES
7AM—6PM PST

702-294-0204
Customer Service • Order Status
9AM—4PM PST

MEAD COMPUTER

1000 Nevada Highway • Unit 101
Boulder City, Nevada 89005

NO SURCHARGE FOR MC/VISA

TERMS:
MC • VISA • COD • CASH
Purchase Orders from Qualified Firms
Personal Checks • AE add 4%

VISA MasterCard AMERICAN EXPRESS

SHIPPING:
UPS • Federal Express

Circle 165 on Reader Service Card

16-BIT RESOLUTION ANALOG-TO-DIGITAL CONVERTER 12,000 SAMPLES/SEC for IBM PC, XT & AT SINGLE PIECE PRICE $475

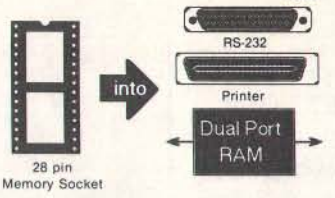
We manufacture a broad line of data acquisition and control hardware and software for Apple and IBM computers.

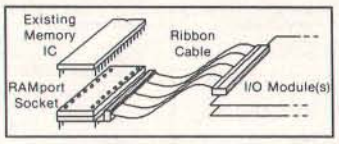
Call for quotes on custom hardware or complete systems.

LAWSON LABS, INC.
5700 RAIBE ROAD
COLUMBIA FALLS, MT 59912
406-387-5355

Circle 148 on Reader Service Card

RAMport™ Expand Retrofit Test





"the last minute problem solvers"
(619) 566-1892
HiTech Equipment
9560 Black Mountain Rd., San Diego, CA 92126

Circle 125 on Reader Service Card

DON'T BUY A BBS!

Until you've seen DLX

- Electronic mail
- XMODEM
- Multiple choice questions
- Essay questions
- Database query system
- User-to-user chatting
- Easily customized
- Up to 9 phone lines
- 2-line version: $200

Requires IBM PC/XT/AT or clone, DOS 2.0 or later

Inner Loop Software
5456 McConnell Ave., Suite 120
Los Angeles, CA 90066
(213) 822-2800 (voice)

Circle 130 on Reader Service Card

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for AUG. 23, 1987

OUTSIDE OKLAHOMA: NO SALES TAX

640K MOTHERBD UPGRADE: Zenith 150, IBM PC;XT, Compaq Portable & Plus; hp Vectra

DYNAMIC RAM			
1Mbit	1000Kx1	100 ns	$26.50
1Mbit	256Kx4	120 ns	32.00
51258	*256Kx1	100 ns	6.95
4464	64Kx4	150 ns	3.50
41256	256Kx1	80 ns	4.95
41256	256Kx1	100 ns	4.40
41256	256Kx1	120 ns	3.40
41256	256Kx1	150 ns	3.20
41264	2-PORT	120 ns	5.25
EPROM			
27512	64Kx8	200 ns	$11.25
27C256	32Kx8	250 ns	6.65
27256	32Kx8	250 ns	5.50
27128	16Kx8	250 ns	4.95
STATIC RAM			
43256L-12	32Kx8	120 ns	$11.95
5565PL-15	8Kx8	150 ns	3.25

*STATIC COLUMN EDRAM 386 COMPAQ

80387-16 $540.00
80287-8 $250.00
8087-2 $160.00

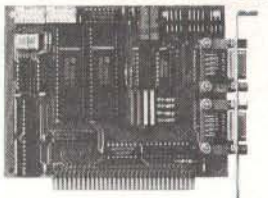
OPEN 6½ DAYS, 7:30 AM-10 PM: SHIP VIA FED-EX ON SAT.
SUNDAYS & HOLIDAYS: SHIPMENT OR DELIVERY, VIA U.S. EXPRESS MAIL

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY:
Th-Sat Air $4/1 lb
Fr: P-1 $10.50/2 lbs

MasterCard/VISA or UPS CASH COD
Factory New, Prime Parts
MICROPROCESSORS UNLIMITED, INC.
24,000 S. Peoria Ave. · BEGGS, OK. 74421 · **(918) 267-4961**
No minimum order. Please note that prices are subject to change. Shipping & insurance extra. & up to $1 for packing materials. **Orders received by 9 PM CST can usually be delivered the next morning, via Federal Express Standard Air @ $4.00, or guaranteed next day Priority One @ $10.50!** All parts guaranteed.

Circle 174 on Reader Service Card

RS-422 Communications Board

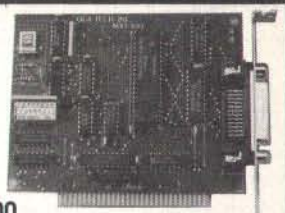


- For IBM-PC/AT/XT and compatibles
- Dual RS-422/RS-485 interface
- Differential drivers to 4000 ft.

Fast Delivery
QUA TECH, INC.
478 E. Exchange St. Akron OH 44304
(216) 434-3154 TLX: 5101012726

Circle 226 on Reader Service Card

IEEE-488



MXI-100

- GPIB controller board for IBM PC/XT/AT
- Control up to 14 Devices
- User friendly Software Commands
- DMA Transfer to 200k byte/sec.

$345.00 including software
QUA TECH, INC.
478 E. Exchange St. Akron, OH 44304
(216) 434-3154 TLX: 5101012726

Circle 227 on Reader Service Card

Prospero Software

Languages for microcomputer professionals

At Prospero we produce PASCAL and FORTRAN-77 COMPILERS for PC compatibles, Atari STs and other micros. They work, they're fast, they produce ultra-compact code, they're all full ANSI standard with no omissions, and many useful extensions. They're federally validated*, object code is inter-linkable, co-processor support is optional*. Linker, librarian and symbolic debugger* are included. Default integers are 32 bit. We support GEM, networking* & 640K Jumbo model*. Prices: MS-DOS products(*) $390. Atari Pascal $149 Fortran $199. Prospero has been serving microcomputer programmers since 1981. For free info & newsletter use the inquiry number. To talk or buy (Amex/Visa/MC) call London 01-741 8531. In the USA call 011-441-741-8531 early in the day. (10/87)

Visit us at Comdex '87 in Las Vegas Nov 2-6 - Booth 2239, South Hall, Convention Center.

Prospero Software Ltd, 190 Castelnau, London SW13 9DH, England. Telex: 8814396.

Circle 315 on Reader Service Card

PAL Programmer

- Works with PC XT/AT
- Programs 20 & 24 pin MMI, NS TI PAL
- Support JEDEC format
- Security Fuse Blow
- DIR, LOAD, SAVE, EDIT, BLANK CHECK, READ, WRITE, VERIFY FUNCTION
- High yield, very reliable
- S/W included

$395

***EPROM programmer (1, 4, 8 socket) $195**
-Supports 24-32 pin EPROM, CMOS EPROM, EEPROM, up to 1 meg.
-27(C)16-27(C)512, 27513, 271000, 27301, 2864A
-Program 27C256 only 30 sec with Quick-pulse
-Vcc=5, 6, 6.25V. Vpp=5, 12.5, 12.75, 13, 21, 25V

***8741/42/48/49 programmer**	**$245**
***TTL IC & MEMORY TESTER**	**$245**
***BIPOLAR ROM programmer**	**$395**
***8751 programmer**	**$345**
***68000 Single Board Computer**	**$395**

VISA **XELTEK** MC
(408) 727-6995
473 Sapena Ct. Unit 24 Santa Clara, CA 95054
CA residents add 6.5% tax. Add $5 for S/H

Circle 301 on Reader Service Card

SERVING WORLDWIDE SINCE 1979

FULLY IBM COMPATIBLE

ONE MEGAbyte 13 MHZ
Turbo 286 ***$1199*** (complete system)
Reviewed by "Byte" January 1987
Turbo XT ***$549*** (complete system)
PORTABLE XT/AT/80386 from $850

SEAGATE HARD DRIVE SPECIAL!

30MB	42MB
$259	$429

Other models and Miniscribe available

SOFTWARE, PC REPAIR, ACCELERATOR BOARDS, NOVELL NETWORK, TAPE BACKUP, ACCESSORIES, etc.

DESKTOP PUBLISHING AND CAD SYSTEM AVAILABLE

ALL NAME BRAND PC'S (IBM, NEC, COMPAQ, AT&T, WYSE, AST, MAC) AND PERIPHERALS AVAILABLE

Please call for the latest reduced pricing. We will beat any other advertised prices.

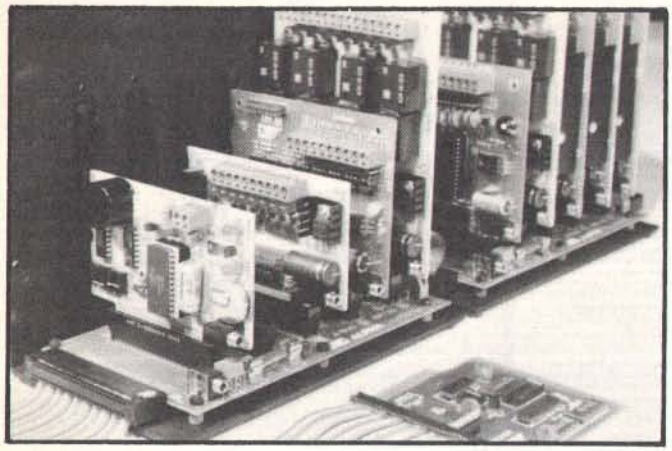
ALL PRODUCTS CARRY TWO-YEAR WARRANTY. BRAND NAME PRODUCTS CARRY MANUFATURER'S WARRANTY.

PC UNIVERSAL SYSTEMS CORP.
122 LUBICH DRIVE
MOUNTAIN VIEW, CA 94040
(415) 964-4808 MON - SAT 9 AM - 8 PM Pacific
SALES REPRESENTATIVES NEEDED

Circle 208 on Reader Service Card

The Amazing A-BUS

NEW



An A-BUS system with two Motherboards
A-BUS adapter (IBM) in foreground

Plug into the future

With the A-BUS you can plug your PC (IBM, Apple, TRS-80) into a future of exciting new applications in the fields of control, monitoring, automation, sensing, robotics, etc.

Alpha's modular A-BUS offers a proven method to build your "custom" system today. Tomorrow, when you are ready to take another step, you will be able to add more functions. This is ideal for first time experimenting and teaching.

A-BUS control can be entirely done in simple BASIC or Pascal, and no knowledge of electronics is required!

An A-BUS system consists of the A-BUS adapter plugged into your computer and a cable to connect the Adapter to 1 or 2 A-BUS cards. The same cable will also fit an A-BUS Motherboard for expansion up to 25 cards in any combination.

The A-BUS is backed by Alpha's continuing support (our 11th year, 50000 customers in over 60 countries).

The complete set of A-BUS User's Manuals is available for $10.

About the A-BUS:

- All the A-BUS cards are very easy to use with any language that can read or write to a Port or Memory. In BASIC, use INP and OUT (or PEEK and POKE with Apples and Tandy Color Computers)
- They are all compatible with each other. You can mix and match up to 25 cards to fit your application. Card addresses are easily set with jumpers.
- A-BUS cards are shipped with power supplies (except PD-123) and detailed manuals (including schematics and programming examples).

Relay Card — RE-140: $129

Includes eight industrial relays, (3 amp contacts. SPST) individually controlled and latched. 8 LED's show status. Easy to use (OUT or POKE in BASIC). Card address is jumper selectable.

Reed Relay Card — RE-156: $99

Same features as above, but uses 8 Reed Relays to switch low level signals (20mA max). Use as a channel selector, solid state relay driver, etc.

Analog Input Card — AD-142: $129

Eight analog inputs. 0 to +5V range can be expanded to 100V by adding a resistor. 8 bit resolution (20mV). Conversion time 120us. Perfect to measure voltage, temperature, light levels, pressure, etc. Very easy to use.

12 Bit A/D Converter — AN-146: $139

This analog to digital converter is accurate to .025%. Input range is −4V to +4V. Resolution: 1 millivolt. The on board amplifier boosts signals up to 50 times to read microvolts. Conversion time is 130ms. Ideal for thermocouple, strain gauge, etc. 1 channel. (Expand to 8 channels using the RE-156 card).

Digital Input Card — IN-141: $59

The eight inputs are optically isolated, so it's safe and easy to connect any "on/off" devices, such as switches, thermostats, alarm loops, etc. to your computer. To read the eight inputs, simply use BASIC INP (or PEEK).

24 Line TTL I/O — DG-148: $65

Connect 24 input or output signals (switches or any TTL device) to your computer. The card can be set for: input, latched output, strobed output, strobed input, and/or bidirectional strobed I/O. Uses the 8255A chip.

Clock with Alarm — CL-144: $89

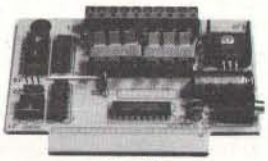
Powerful clock/calendar with: battery backup for Time, Date and Alarm setting (time and date); built in alarm relay, led and buzzer; timing to 1/100 second. Easy to use decimal format. Lithium battery included.

Touch Tone® Decoder — PH-145: $79

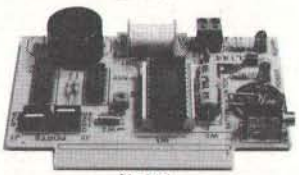
Each tone is converted into a number which is stored on the board. Simply read the number with INP or POKE. Use for remote control projects, etc.

A-BUS Prototyping Card — PR-152: $15

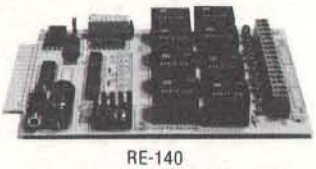
3½ by 4½ in. with power and ground bus. Fits up to 10 I.C.s



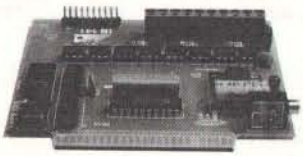
ST-143



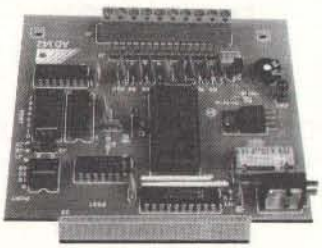
CL-144



RE-140



IN-141



AD-142

Smart Stepper Controller — SC-149: $299

World's finest stepper controller. On board microprocessor controls 4 motors simultaneously. Incredibly, it accepts plain English commands like "Move arm 10.2 inches left". Many complex sequences can be defined as "macros" and stored in the on board memory. For each axis, you can control: coordinate (relative or absolute), ramping, speed, step type (half, full, wave), scale factor, units, holding power, etc. Many inputs: 8 limit & "wait until" switches, panic button, etc. On the fly reporting of position, speed, etc. On board drivers (350mA) for small steppers (MO-103). Send for SC-149 flyer.

Remote Control Keypad Option — RC-121: $49
To control the 4 motors directly, and "teach" sequences of motions.

Power Driver Board Option — PD-123: $89
Boost controller drive to 5 amps per phase. For two motors (eight drivers).

Breakout Board Option — BB-122: $19
For easy connection of 2 motors. 3 ft. cable ends with screw terminal board.

Stepper Motor Driver — ST-143: $79

Stepper motors are the ultimate in motion control. The special package (below) includes everything you need to get familiar with them. Each card drives two stepper motors (12V, bidirectional, 4 phase, 350mA per phase).

Special Package: 2 motors (MO-103) + ST-143: **PA-181: $99**

Stepper Motors — MO-103: $15 or 4 for $39

Pancake type, 2¼" dia, ¼" shaft, 7.5°/step, 4 phase bidirectional, 300 step/sec, 12V, 36 ohm, bipolar, 5 oz-in torque, same as Airpax K82701-P2.

Current Developments

Intelligent Voice Synthesizer, 14 Bit Analog to Digital converter, 4 Channel Digital to Analog converter, Counter Timer, Voice Recognition.

A-BUS Adapters for:

IBM PC, XT, AT and compatibles. Uses one short slot.	AR-133...$69
Tandy 1000, 1000 EX & SX, 1200, 3000. Uses one short slot.	AR-133...$69
Apple II, II+, IIe. Uses any slot.	AR-134...$49
TRS-80 Model 102, 200 Plugs into 40 pin "system bus".	AR-136...$69
Model 100. Uses 40 pin socket. (Socket is duplicated on adapter).	AR-135...$69
TRS-80 Mod 3,4,4 D. Fits 50 pin bus. (With hard disk, use Y-cable).	AR-132...$49
TRS-80 Model 4P. Includes extra cable. (50 pin bus is recessed).	AR-137...$62
TRS-80 Model I. Plugs into 40 pin I/O bus on KB or E/I.	AR-131...$39
Color Computers (Tandy). Fits ROM slot. Multipak, or Y-cable.	AR-138...$49

A-BUS Cable (3 ft, 50 cond.) — CA-163: $24

Connects the A-BUS adapter to one A-BUS card or to first Motherboard.

Special cable for two A-BUS cards: CA-162: $34

A-BUS Motherboard — MB-120: $99

Each Motherboard holds five A-BUS cards. A sixth connector allows a second Motherboard to be added to the first (with connecting cable CA-161: $12). Up to five Motherboards can be joined this way to a single A-BUS adapter. Sturdy aluminum frame and card guides included.

Add $3.00 per order for shipping.
Visa, MC, checks, M.O. welcome.
CT & NY residents add sales tax.
C.O.D. add $3.00 extra.
Canada: shipping is $5
Overseas add 10%

a Sigma Industries Company

ALPHA Products

242-B West Avenue, Darien, CT 06820

Technical info: (203) 656-1806
Orders only Except in CT 800 221-0916
Connecticut orders: (203) 348-9436
All lines open weekdays 9 to 5 Eastern time

Circle 10 on Reader Service Card

68020

- Multi-User, Multi-tasking
- 2 to 30 Serial Ports
- 512K to 14.5 Megabytes RAM
- Real-Time Clock/Battery Backup
- Full SCSI Interface with DMA
- Bundled Software:
  - OS9/68020 Operating System
  - Basic
  - C
  - Utilities
- Options:
  - 68881 Math Coprocessor
  - 2 Meg RAM Upgrade Boards
  - Many more Options

QT20X Prices start at $2195. Board level to complete systems available.

FRANK HOGG LABORATORY, INC.
770 JAMES STREET
SYRACUSE, NEW YORK 13203
315/474-7856 TELEX 646740

Circle 106 on Reader Service Card

100 MHz Logic Analyzer for just $999.00!

Turn your PC/XT/AT into a powerful test instrument.

- Plugs into a slot with the 100MHz probe on the outside for convenient test setup.
- 24 Channels 25KHz to 25MHz
- 6 Channels at 100MHz
- Internal and External clock to 100MHz
- Threshold voltage: TTL, ECL variable from −10V to +10 V.
- Comprehensive Menu driven software included

PAL/EPROM PROGRAMMER

card for the PC/XT/AT **$389.00**

- Programs all 20 and 24 Pins MMI, TI, NS Pals.
- Programs all 2716 to 27512 Eproms including A
- Pal/Eprom socket stays outside the PC for convenient programming set up.
- Comprehensive menu driven software included

Swisscomp Inc
5312-56th Commerce Park, Tampa, FL 33610
Info: (813) 628 0906
Orders: 1-(800) 888 0304 extension 45

Circle 264 on Reader Service Card

Back, by popular demand.

Just a few years ago, illegal hunting and encroaching civilization had all but destroyed the alligator population in the south. They were added to the official list of endangered species in the United States.

Now alligators have made a comeback.

Conservationists intent on preserving this legendary reptile helped the alligator get back on its feet. Once again some southern swamps and marshes are teeming with alligators.

With wise conservation policies, other endangered species have also made comebacks . . . the cougar, gray whale, Pacific walrus, wood duck, to name a few.

If you want to help save our endangered species, join the National Wildlife Federation, Department 106, 1412 16th Street, NW, Washington, DC 20036.

MODEM

Internal: (with software, Made in U.S.A.)

1200-B $ 75
2400-B $175

External: (Bitcom software extra $10.)

1200 $ 85
2400 $185

Dealer Inquiries Welcome

JACO COMPUTER PRODUCTS
989 E. California Ave.
Suite 4
Sunnyvale, CA 94086
TEL: (408) 746-2000
FAX: (408) 446-3825

Circle 135 on Reader Service Card

IEEE488

Technology that hits the mark

- For **IBM-PC/XT/AT/IC/RT6150** and all other compatible computers
- For PHILIPS PC :**YES**
- **HP commands** (enter, clear etc.) implemented
- **SRQ/ASYST** compatible
- **64 kByte** memory capacity
- **DMA** and **INTERRUPT** can be activated by **simple commands**
- **HELP functions, SYNTAX** monitoring in **clear text**
- BASIC, BASIC(compiled), TURBO-BASIC, (TURBO-) PASCAL, MODULA-2, FORTRAN, C, ASSEMBLER

DEALER + OEM WELCOME

ines
Messtechnik
Datenverarbeitung

ines GmbH
Neuenhöfer Allee 45
5000 Köln 41
West-Germany
Phone: -49-221-438659
Telefax: 2627-221-4237 gizkln
FAX: -49-221-491871

Circle 129 on Reader Service Card

Add-Ons for the Blind

What you add on to your computer, if you're a blind operator, is almost more important than the computer itself.

Scanners, modems, braille printers, speech synthesizers, braille output devices and a host of other peripherals are described in "Add-Ons: The Ultimate Guide to Peripherals for the Blind Computer User."

The product reviews contained in this book are written by those who know them best—blind computer users.

$16.95 for braille or cassette
$19.95 for print.

Send orders to:

National Braille Press Inc.
88 St. Stephen Street, Boston, MA 02115
(617) 266-6160

NBP is a non-profit braille printing and publishing house.

Advertise your computer products through **BYTE BITS** (2" x 3" ads)

For more information call Dan Harper at 603-924-6830

BYTE
70 Main St.
Peterborough, NH 03458

Circle 320 on Reader Service Card

California Digital

17700 Figueroa Street ● Carson, California 90248

$129 PLOTTERS

The Sweet "P" 100 was private labeled for the Epson corporation under the Comrex Brand. This plotter makes short work of translating financial and numeric data into a graphic presentation. Many ready to run programs such as Auto/CAD and Lotus 1-2-3 already support this plotter.

The Sweet "P" 100 features programmable paper sizes up to 8½ by 120 inches, 6 inch per second plot speed and 0.004" step size. Easy to implement Centronics interface allows the Sweet "P" 100 immediate use with the printer port of most personal computers.

This is your opportunity to purchase a plotter which was originally priced at $795 for only $129.

Also available is a support package which includes demonstration software, interface cable, a multicolor pen assortment and a variety of paper.

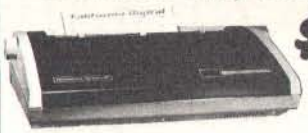
$2495 $759 80 Character Daisy Wheel Printer

These Fujitsu Daisy Max 830 were manufactured for Motorola's Computer Division. The purchase order was canceled and Fujitsu was forced to liquidate these 80 character per second daisy wheel printers at "fire sale" prices.

Features: bullet proof construction, your choice of either Centronics parellel or RS-232 serial interface, Diablo 630 wheels and commands, programmable line spacing in increments of 1/96" and column spacing of 1/120". The printer is also capable of underscoring, bold overprint, shadow print, centers and justifies along with vector plotting.

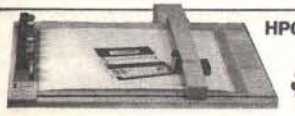
Factory suggested price of the Daisy Max 830 was $2495, California Digital is offering this liquidated special at only $759. Tractor and sheet feeders available.

18 Character Daisy Wheel Printer



$99

The Alphacom Daisy Wheel Printer was an excellent value at $495, but we have been asked to assist in liquidating the remaining inventory at only $99. The AlphaCom prints at 18 character per second, is 630 compatible, accepts Diablo daisy wheels and ribbons. Personality modules additional.



HPGL ● 11" by 17" $795

Western Graphtec Model 2000 operates under the Hewlett Packard graphic language and has both parellel and serial interface. Size "B" plotter, 11" by 17" flat bed with eight self capping color pens. Maximun plotting speed 10" per second, resolution .05mm with repeatability of .004".

To blow out the remaining inventory, California Digital has slashed the price of MP/2000 to $795. Hurry! only 180 plotters left.

PLOTTERS	
Sweet "P" 100 (Comrex) 6½ by 120"	$120
Houston Instruments DMP29, 11 by 17	1779
Houston Instruments DMP40, 11 by 17, B size	959
Houston Instruments DMP41/42 C/D 24 by 36	3770
Houston Inst. DMP51/52MP C/D, 14 pen	4859
Houston Instruments DMP56, E size 34 by 44	4795
Houston Instr. PD885, 11 by 17 multi-pen	579
Roland DYX-860 11 by 17 multi-pen B color	959
CalComp 1043GT plotter	7899
DIGITIZERS ● MOUSE	
Hitachi Tiger Tablet 11 by 11"	659
Summagraphics Summasketch 12" 4 button	419
Summagraphics SummaMouse 100 line	99
MicroSoft serial mouse with paint brush	139
MicroSoft bus mouse card w/paint brush	129

PRINTERS

IBM Thermal printer, 80 col., serial	$39
Fujitsu D830 80 cps., daisy wheel	759
Silver Reed EXP-800 136 col., 40 cps.	729
Juki 6300 daisy wheel 40 cps.	819
NEC 8850 Spinwriter daisy wheel 55 cps.	1159
NEC P6/660P 10" 216 cps. NLQ.	469
NEC P7/760P 15" 216 cps. NLQ.	659
Olympia NP80, 200 cps draft, 40 nlq.	329
Olympia NP136, 15" same as above	459
Epson FX86E NLQ 10" 240 char/sec.	399
Epson FX286E NLQ 15" 240 char/sec.	539
Epson EX1000 300 cps, NLQ/54 cps.	599
Citizen MSP-10 160 cps. 10"	299
Citizen MSP-15 160 cps. 15"	449
Okidata 182 80 column, par'l.	239
Okidata 192+ 136 column, par'l.	345
Okidata292 136 column, parellel.	489
Panasonic P1080/I, 10" 120 cps.	229
Panasonic P1091/I, 10" 160 cps.	299
Panasonic P1592 15" 180 cps.	429
Star Gemini NX10, 120 cps 10" NLQ.	239
Star Gemini NX15, 120 cps 15" NLQ.	359
Toshiba 321, 24 wire head 216 cps; NLQ.	519
Toshiba 341, 24 wire head 216 cps. 15".	629
Printronics P300 dot matrix, 300 LPM	3995
Printronics P600 dot matrix, 600 LPM	5795
LASER PRINTERS	
Apple Laser Writer Plus; Postscript	4295
QMS PS/800 2 meg. Postscript, 8 pgs.	4295
Hewlett Packard Series II, laser printer	1795
Texas Instr. OmniLaser 2108 P/S, 8 pgs.	4295
Texas Inst. OmniLaser 2115 P/S, 15 pgs	5595
Quadram Quad/Laser, 5 Megabytes	2995

NOW YOUR COMPUTER CAN READ!!

$159

Omni-Reader... the first optical character reader **designed and priced for the small computer**

COPY:
•Manuscripts •Contracts •Articles
•Forms •Invoices

APPLICATIONS:
•Mailing Lists •Editing •Data Base Management •Transfering information between incompatible systems

Uses a standard RS-232 serial port hookup to interface easily with your computer.

20/20 Bernoulli Box

~~$3495~~

$1595

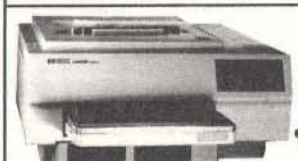
California Digital has purchased these 20/20 Bernoulli systems from Iomega. The units needed some minor alignment and had to be sent back to Iomega. These have to sold as as reconditioned... but for all practical purpose they are new and come with a **one year Iomega factory warranty.**

The 20/20 Bernoulli Box features removable cartridges, and delivers reliability, expandability, transportability, security and speed in one versatile subsystem. It lets you transfer megabytes of information safely and swiftly for primary or backup storage. Or combine several software programs onto a single cartridge for easy switching from one to another.

Reliable... the Box has incredible resistance to shock and vibration completely eliminating the possility of head crash.

security essential? Don't lock up your system... just lock up the cartridges.

20+20 Subsystem... **$1595;** Non bootable controller... **$159;**
Bootable controller... **$189;** 20 Megabyte Cartridges...

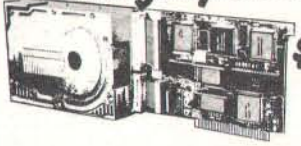


HEWLETT PACKARD LASER JET II $1795

Standard features of the new Hewlett Packard Series II Laser printer: 512 K byte memory expandable to 4 Megabytes, both serial and parallel ports. List price $2495 California Digital price $1795. Memory upgrade, type fonts and toner cartridges available.

Other Laser Printers available:
Texas Instruments ● Okidata ● Apple ● Ricoh
Qume ● AST Research ● QMS ● Xerox ● Canon
Quadram ● Centronics ● CIE C.Itoh ● DataProducts

21 Megabyte Gold Card



$459

Also available 31 Megabytes at only $559.

The fastest, lowest powered, longest warrantied, most durable, highest capacity, most reliable, lowest priced HARD-DISK-ON-A CARD available in the world today.

• *$5ms Access Time • Fastest Available • Automatic Head Unloading • Protects Heads and Media • 2K Sector Buffer • Increases System Throughput • High Reliability: 20,000 hr. MTBF No one else even close • 15.5 Watt Power Consumption • Lowest Available • 2 Year Warranty Longest Available*

$35

We have them again... The Remex 480 was a sell out two years ago but we located an additional 10,000 units and are offering these 2/3 height IBM/PC compatible 360K/Byte drives at only $35 each at quantity two.

	One	Two	Ten
REMEX 480 ⅔ height for PC	39	35	29
TANDON 65L/2 360K, ½ ht.	79	75	72
TANDON 101/4 full ht. 96 TPI.	119	109	99
FUJITSU 5¼" half height	95	89	82
MITSUBISHI new 501 half ht.	119	109	105
MITSUBISHI 504A AT comp.	149	139	135
TEAC FD55BV half height	109	99	89
TEAC FD55FV 96 TPI, half ht.	119	109	105
TEAC FD55GF for IBM AT	149	139	135
PANASONIC 455 Half Height	109	99	89
PANASONIC 475 1.2 Meg./96	119	115	109
Switching power supply			49
Dual enclosure for 5¼" drives			59

3½" DISK DRIVES

SONY MP-53W 720K/Byte	139	129	123
SONY MP-73W, 2 Meg.	179	169	call
TEAC 35F 720 K/Byte	129	119	115
TEAC 35X, 2 Meg.	call	—	—
5¼" form factor kit		—	20

$495 DEC/TS03 Tape Drive

Manufactured by Kennedy Magnetics for Digital Equipment. Kennedy Model 9700 features BPI, 12.5 IPS, nine track with seven inch reels. Original price over $3000.
Other tape drives available: Pertec • Wangco • Perkin Elmer.

U.S. Robotics 2400 $189

The US Robotics Micro 2400 modem is one hundred percent Hayes compatible, auto dial, auto answer, auto everthing, loudspeaker included. A super value at only $189.

Smarteam 2400 $259

The Smarteam 2400 offers all the features of the Hayes Smart Modem 2400 for a fraction of the price. Now is your opportunity to purchase a 2400 baud modem for only $259.
Also available: The Smarteam 1200 at only $119

MODEMS	
Avatex 1200 baud external, Hayes	99
Hayes Smartmodem 2400 baud modem	529
Smarteam 2400 Hayes Compatible	259
Team 1200 Hayes Compatible, 300/1200	119
Smarteam 1200B IBM 1200 baud card	119
UltraLink 1200 data and voice, Bell 202	99
Prometheus 1200 super features	289
Prometheus 1200B internal PC	199
Signalman Mark VI, 300 baud internal PC	35

Seagate $359

30 MEGABYTE WINCHESTER HARD DISK KIT

20 Megabyte Kit $319

Five Inch Winchester Disk Drives

Price does not include controller.	each	two+
SEAGATE 225 20 Meg. ½ Ht.	269	259
SEAGATE 238 30 Meg. RLL	299	289
SEAGATE 4026 26 M. 35mS.	559	539
SEAGATE 4051 51 M. 35mS.	695	659
SEAGATE 4096 96 M. 35mS.	859	829
MINISCRIBE 3425 25 m 85ms.	279	247
MINISCRIBE 3650 50 m 61 ms.	419	399
FUJITSU 2242 55 M. 35mS.	1299	1229
FUJITSU 2243 86 M. 35mS.	1695	1619
RODIME RO-204E 53 Meg.	995	959
CONTROL DATA 94155-86 M.	1829	1779
MAXTOR XT1140 140 Meg.	2595	2529
TOSHIBA MK56 70 M. 30mS.	1789	1729

● Winchester Controllers for IBM/PC ●	
XEBEC 1220 with floppy controller	189
DTC 5150CX	119
OMTI 5520 half card	99
OMTI 5527 RLL controller	129
ADAPTEC 2070 RLL controller	179
ADAPTEC 2010A	159
WESTERN DIGITAL WD/1002WX2	89
● SCSI/SASI Winchester Controllers ●	
XEBEC 1410A 5¼" foot print	219
WESTERN DIGITAL 1002-05E 5¼"	289
OMTI 20L	89
● Winchester Accessories ●	
Installation Kit with manual	10
Winchester enclosure and supply	139
Dual 20/34 cable set	25
Switching power supply	49

Shipping: First five pounds $3.00, each additional pound $.50
Foreign orders: 10% shipping, excess will be refunded.
California residents add 6½% sales tax. ● COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.

Telefax ● (213) 217-1951

VISA

master charge

TOLL FREE ORDER LINE
(800) 421-5041
TECHNICAL & CALIFORNIA
(213) 217-0500

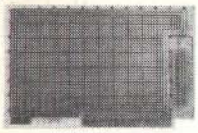
Worldwide • Since 1974

• QUALITY COMPONENTS • COMPETITIVE PRICING • PROMPT DELIVERY

Mail Order Electronics · Worldwide
Jameco ELECTRONICS

NEW! General Purpose Prototype PC Boards

- Wire Wrap
- Component Testing
- Point-to-Point Wiring
- 31/62 Connection



JE417 (Pictured)

JE411 (6½", No Pads, Gen. Purp.) $12.95
JE415 (6½", No Pads, PC/XT) $14.95
JE417 (6½", Plated w/Pads, PC/XT) . . . $19.95

Extender Boards Designed for Troubleshooting and Testing

JE419 (Pictured)

JE419 (5¼" Extender, 22/44 Connector) . . $19.95
JE421 (4¾" Extender, 31/62 Connector) . . $19.95

Commodore VIC-20 Motherboard

CV20

May have to troubleshoot or just use for spare parts.
CV20 Includes: (1) 6560, (2) 6522, (1) 6502, (2) 6116P-4, and much more!

CV20 (VIC-20 Motherboard) . . . . . $ 9.95
089033 (SAMS VIC-20 Schematics) . . . $19.95

Additional Accessories for Commodore VIC-20, C-64 & C-128

JE232CM (Pictured)

***CM1** (300B Modem VIC-20, C-64) . $19.95
***JE232CM** (RS232 Inter. VIC-20, C-64) . $39.95
CPS10 (C-64 Power Supply) $39.95
CPS128 (C-128 Power Supply) $59.95
*Also compatible with C-128 in 64 mode only.

ZUCKERBOARD

TANDY 1000 Expansion Memory Half Card

Expand the memory of your Tandy 1000 (128K Version) to as much as 640K. Also includes DMA controller chip.

TE512 Includes 512K RAM. $119.95
TANC Plug-in Clock option chip (only) $39.95

20Meg Hard Disk

T20MB 20MB Hard Disk Drive Board for Tandy 1000. . . . . $494.95
SX20MB 20MB Hard Disk Drive Board for Tandy 1000SX. $499.95

TANDY 1000 Multifunction Board with Clock Calendar

Expand the memory on your Tandy 1000 (128K Version) to as much as 640K. Complete with an RS232 port, clock/calendar, RAM Disk, Printer Spooler and on-board DMA controller chip.

MT512 Includes 512K RAM. $199.95

INTRODUCING JAMECO'S NEW COMPUTER KITS!!

Jameco's IBM™ AT Compatible Kit!
Mini-286 6/8/10/12 MHz Kit!

EGA Monitor TE5154 $399.95
EGA Card JE1055 $149.95
(not included)

Part No.	Description	Price
JE1043	1.2M/360K Floppy Control.	$ 49.95
JE1015	XT/AT Style Keyboard. . . .	$ 59.95
41256-120	512K RAM (18 Chips) . .	$ 71.10
JE1012	Baby AT Flip-Top Case. . . .	$ 69.95
JE1032	200W Power Supply.	$ 89.95
JE1022	5¼" High Density Disk Drive	$109.95
JE1003	Baby AT Motherboard (Zero-K RAM-incl. Award BIOS ROM) .	$399.95

NEW

Regular List $850.80
SAVE $50.85!

JE1008 IBM™ AT Compatible Kit. $799.95

Jameco's IBM PC/XT Compatible Kit

SAVE $77.15

4164-150	128K RAM (18 Chips). . . .	$22.50
JE1040	Floppy Controller Card . .	$29.95
JE1010	Flip-Top Case.	$34.95
JE1015	XT/AT Style Keyboard . . .	$59.95
JE1030	150 Watt Power Supply . .	$69.95
JE1050	Mono/Graph. Crd. w/PPort	$59.95
JE1020	5¼" DSDD Disk Drive. . . .	$89.95
GREEN	12" Mono. Green Monitor	$99.95
JE1000	XT Motherboard (Zero-K RAM-incl. Award BIOS ROM).	$89.95

FREE! QUICKSOFT PC WRITE WORD PROCESSING SOFTWARE INCLUDED!

Regular List $557.10

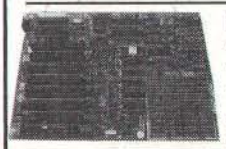
JE1004 (IBM™ PC/XT Compatible Kit). $479.95

Jameco's 4.77/8MHz Turbo IBM Compatible Kit

Same as JE1004 except comes with 640K RAM, JE1001 (Turbo) 4.77/8MHz motherboard, JE1071 multi I/O with controller and graphics, and AMBER monitor.

SAVE $70.70 ***Regular List $670.65***

JE1005 (IBM™ PC/XT Turbo Compatible Kit) . $599.95



IBM Compatible Motherboards

- 4.77/8MHz operation (Turbo only)
- 8087 Math Co-processor capability
- BIOS ROM included

SALE

JE1001 4.77/8MHz . . ~~$129.95~~ $104.95
JE1000 4.77MHz . . . . ~~$109.95~~ $ 89.95

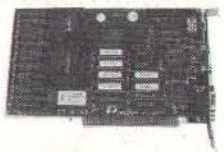
Additional Add-Ons Available!

Color Graphics Card for PC/XT/AT

• Text: 40 or 80 x 25 • Graphics: 320 or 640 x 200 • Parallel Printer Port • Manual included

JE1052. . . . . $49.95

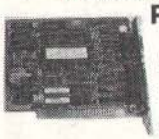
EGA Card for PC/XT/AT



• Graphics: 720 x 348 • 16 out of 64 colors • Manual included

JE1055. . . . . $149.95

I/O Cards for PC/XT/AT

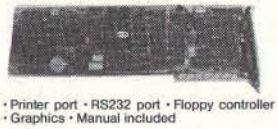


• Printer Port
• RS232 Port
• Game Port
• Manual included

JE1060 (Pictured)

JE1060 I/O for XT. . . . $59.95
JE1065 I/O for AT. . . . $59.95

Multi I/O w/Controller & Graphics for PC/XT

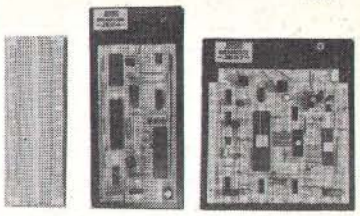


• Printer port • RS232 port • Floppy controller • Graphics • Manual included

JE1071. . . . . $119.95

Jameco Solderless Breadboard Sockets

NEW



JE23 JE24 JE27

Part No.	Dim. L" x W"	Contact Points	Binding Posts	Price
JE20	6½ x ¾	200	0	$ 2.29
JE21	3¼ x 2⅛	400	0	$ 4.49
JE22	6½ x 1⅜	630	0	$ 5.95
JE23	6½ x 2⅛	830	0	$ 7.49
JE24	6½ x 3⅛	1,360	2	$14.95
JE25	6½ x 4¼	1,660	3	$22.95
JE26	6⅞ x 5¾	2,390	4	$27.95
JE27	7¼ x 7½	3,220	4	$37.95

Jameco Extended 80-Column Card for Apple *IIe*

• 80 Col./64K RAM • Doubles amount of data your Apple *IIe* can display as well as its memory capacity • Ideal for word processing • Complete with instructions

JE864 $49.95

ADD12 (Disk Drive II, II+, *IIe*) **$99.95**

Additional Apple Compatible Products Available

NEW!

ST225K (Pictured)

Seagate 20, 30 & 40MB Half Height Hard Disk Drives

ST225	20MB Drive only (PC/XT/AT)	$269.95
ST225K	20MB w/Controller (PC/XT)	$319.95
ST238K	30MB w/Cont. (PC/XT/AT) . .	$339.95
ST251XT	40MB w/Cont. Card (PC/XT) .	$549.95
ST251AT	40MB w/Cont. Card (AT) . . .	$589.95

Jameco PC/XT & AT Compatible Disk Drives

JE1022 (Pictured)

JE1020 (360K Drive, PC/XT/AT) . . . $ 89.95
JE1022 (1.2MB, AT Compatible) . . . $109.95

DATA BOOKS

30003	National Linear Data Book (82).	$19.95
30005	Logic Data Book - Vol. II (84).	$19.95
30009	Intersil Data Book (87).	$14.95
21398	CMOS Cookbook (86).	$14.95
210830	Intel Memory Handbook (87).	$17.95
230843	Intel Microsystem Hndbk. Set (87). . . .	$24.95

MUFFIN/SPRITE-STYLE FANS

TA450S. $11.95
Torin Industries (4.68" sq., 50 cfm)
SU2A1. . . . . $11.95
EG&G Rotron (3.125" square, 34 cfm)

$20 Minimum Order — U.S. Funds Only
Shipping: Add 5% plus $1.50 Insurance

California Residents: Add 6%, 6½% or 7% Sales Tax

IBM is a registered trademark of International Business Machines

Data Sheets — 50¢ each
Prices Subject to Change

Send $1.00 Postage for a FREE Seasonal Flyer
FAX 415-592-2503
10/87

MasterCard

Mail Order Electronics · Worldwide
Jameco ELECTRONICS®

VISA®

Send $1.00 Postage for a FREE 1988 CATALOG
Telex: 176043

1355 SHOREWAY RD., BELMONT, CA 94002 • *FOR ORDERS ONLY 415-592-8097* • ALL OTHER INQUIRIES 415-592-8121

ACP's Software Sale!

VALUES SINCE 1976!

ASHTON TATE
dBase III Plus 1.1	CALL
Framework II 1.1	CALL
Multimate Advantage II	CALL

BORLAND
Turbo Tutor 2.0	$25.00
Turbo database Toolbox 1.2	41.00
Turbo Lightning 1.0	58.00
Turbo BASIC 1.0	58.00
Sidekick 1.5	50.00
Eureka 1.0	59.00
Turbo C 1.0	59.00
Reflex 1.1	86.00
Superkey 1.1	59.00

BRODERBUND
Graphics Library 1	$23.00
Graphics Library 2	23.00
Print Shop	34.00

CROSSTALK COMM.
Crosstalk XV/v. 3.61	$95.00

DAC
DAC Easy Payroll	$33.00
DAC Easy Accounting	45.00

GENERIC
Generic CADD 3.0	$68.00

JAVELIN
Javelin 1.1	$69.95

MICROPRO
Wordstar Professional Rel. 4	$257.00
Wordstar 2000 Plus Rel. 2	288.00

MICRORIM
Rbase Graphics 1.0	$160.00
Rbase System V 1.1	415.00

MICROSOFT
Window 1.03	$64.00
Multiplan 3.02	122.00
Project 3.01	240.00
Word	225.00
Quick BASIC 2.01	62.00

MIGENT
Ability Plus	SALE

MONOGRAM
Dollars & Sense	$110.00

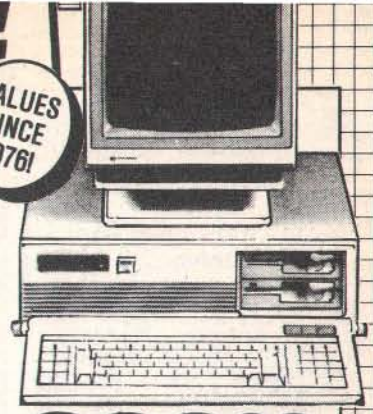
QUARTERDECK
Desqview 2.0	$63.00

SOFTWARE PUBLISHING
Harvard Prof. Publisher	$405.00
First Choice 1.0	109.00

SYMANTEC
Q. & A. 2.0	$219.00

WORDPERFECT
Wordperfect 4.2	$245.00
Library 1.1	65.00

EGA SPECIALS
- EGA Monitor plus EGA Card ..... $499.
- NEC Multisync plus EGA Card ..... $699.



899.88

Advanced 286

SHOWN WITH OPTIONAL MONITOR AND SECOND DISK DRIVE

- 80286 6/10 Mhz Switchable
- 640K RAM Expandable to 1Mb
- AT Keyboard • 8 I/O Slots
- 1.2Mb Floppy w/Controller
- Serial and Parallel Ports

1 YEAR WARRANTY!

PLUS SPECIAL OFFER...
AST "ADVANTAGE AT® w/3Mb ...List $1745.00 ...ONLY $399.00
That's right...get a 3Mb factory populated AST Advantage card plus serial/parallel I/O, tested! — With purchase **ONLY $399.00**
PLUS... FREE Software including SIDEKICK®, DESQVIEW® and SUPERPAK®

FACTORY WARRANTY INCLUDED — OPTIONS AVAILABLE

Sale! EPSON EQUITY II $799.

- V-30 (8086 Compatible) Processor
- Dual Speed 4.77/7.16 MHz
- Built-in Hi-Res TTL & CGA/RGB
- 640Kb And Clock/Calendar Standard
- Deluxe Superb Keyboard
- Single Floppy (360Kb) Standard
- 5 Full Size Option Slots
- Call For 1.2Mb/HD/Color Options

WHILE STOCK LASTS!

BARE BONES PRICE!!! Advanced $288.

8 MHz XT Turbo

- 4.77/8MHz Switchable
- Zinc-lined FCC Case
- 0K, expandable to 640K
- 150W Power Supply
- XT/AT Deluxe Keyboard
- Phoenix BIOS
- Runs all Major software written for IBM

IBM COMPATIBLE CARDS
AM200 "Diamond-Pak" (HGA, FD, (2)S, P, C, G) All-In-One	$139.95
AM210 Color/Printer/CGA	69.95
AM230 CGA/TTL/Printer/132 Col.	79.95
AM240A Mono/Printer/Herc. (1/2)	69.95
AM250 Mono/Printer/132 Col.	69.95
AM271 EGA w/256K RAM (1/2)	169.95
AM273 EGA (Genoa Comp.) (1/2)	239.95
AD340 MIO w/Floppy	69.95
AD410 (2) Floppy I/O w/cables	29.95
AC340 Game Card PC/XT/AT	39.95
AC511 Parallel Port PC/XT/AT	39.95
AC530 Serial Port PC/XT/AT	49.95
AR319 0K Multi-function (6 Pk.)	69.95
AM640 Floppy-Hard Controller/AT	189.95
AS956 XT Turbo Motherboard/0K	99.95
AS949 AT Turbo Motherboard/0K	379.95
AS951 Baby AT Motherboard/0K	379.95
1200 Ba. Hayes Modem (int. or ext.)	98.00
2400 Ba. Ha. Modem (int. or ext.)	239.00

ACCESSORIES
NC100 256K Printer Buffer (par.)	$149.95
NC101 Parallel to Serial Converter	89.95
NC102 Serial to Parallel Converter	89.95
NC205 Switch Box 3636-AB	34.95
NC201 Switch Box 2525-AB	34.95
Buffalo SX Multi-Connection	475.00

HARDWARE SPECIALS!!!

AST - 2 Yr. Warranty
Advantage AT w/0K	SALE	$129.95
Advantage AT w/1.5Mb	SALE	389.95
Advantage AT w/3.0Mb	SALE	469.00
Rampage AT w/512K	SALE	269.95
Preview I/O XT/AT		189.95
AST MP II 64K exp. to 384K w/clk		99.95
AST Mini Pak 1/2 card w/384K		99.95
Combo Plus w/0K ser, par, clock		69.95
Sixpack Premium w/256K		299.95
Advantage Premium 512K		CALL
Knight Security Software (Sixpack)		99.95
AST Turbo Laser		3995.00
AST Premium 286 Model 170		CALL

EVEREX
Evercom II 1200 Baud Modem (int.)	$119.00
Evercom II 2400 Baud Modem (int.)	198.00

HAYES (2 Yr. Warranty)
1200 RS-232 External	$299.00
1200B w/SMARTCOM (int.)	299.00
2400 RS-232 External	449.00
2400 w/SMARTCOM II (int.)	449.00

HERCULES
Hercules Incolor Card	CALL
Hercules Plus Graphics	188.00

INTEL (5 Yr. Warranty)
Above Board AT/128K	$349.00
Above Board 286/512K	435.00
Inboard 386/AT	1488.00
8087 Coprocessor	105.00
8087-2	145.00
80287-6	165.00
80287-8	260.00
80287-10	449.00

KEYTRONICS
5151 Deluxe Keyboard	$189.95
Keytronics 101 Key AT (New)	149.00
ACP 5150 Keyboard	58.95
ACP 5151 Deluxe Keyboard	79.95
ACP 5160 AT/XT Keyboard	66.95
ACP 5152 XT/AT Keyboard	79.95

MEMORY
64K/150ns	$1.19
64K/120ns	1.49
256K/150ns	3.29
256K/120ns	3.49
256K/100ns	4.99
1Mb Chip 100ns Ea.	33.95

BERNOULLI BLOWOUT
Dual 20Mb top of the line (refurb)
Retail $3540
$1499

MIGENT (1 Yr. Warranty)
Pocket Modem 1200B w/software	$159.00

MOUSE SYSTEMS (3 Yr. Warranty)
PC Mouse w/Pop-ups	$99.00
Torrington Mouse	$89.00

NEC (2 Yr. Warranty)
Multisync EGA Monitor	$549.00
GB-1 Adapter Card (640 x 480)	365.00
Multispeed Laptop Computer	CALL

ORCHID (2 Yr. Warranty)
Turbo EGA	CALL
Tiny Turbo 286	439.00
PC Turbo 286E/1Mb	788.00
Jet 386 PC to 386	866.00

QUADRAM
Silver Quadboard PC/XT	$129.95
Liberty PC/XT 0K	169.00
Liberty 2Mb	408.00
Quadsprint PC/XT Accellerator	166.00
Quad EMS I/O + 256K	339.00

PRINTERS

BROTHER
M2024L (24 Pin)	SALE	$699.00
M1109 100 cps		239.00
M1409 45 cps NLQ		359.00
M1509 45 cps NLQ		439.00
M1709 50 cps NLQ		488.00

EPSON

LX-800 New! (80 col, 180 cps, 9 pin) ... $169.	
EX-800 (80 col., 300 cps)	$407.00
EX-1000 (136 col, 300 cps, 9 pin)	499.00
FX-286e (136 col, 200 cps, 9 pin)	428.00
FX-86e (80 col, 200 cps, 9 pin)	307.00
LQ-800 (80 col, 180 cps, 24 pin)	429.00
LQ-1000 (136 col, 180 cps, 24 pin)	515.00
GQ-3500 Laser Printer	1888.00
LQ-2500 (136 col, 400 cps, 24 pin)	869.00

TOSHIBA
P321SL 24 Pin LQ Printer	$449.00
P341E 24 Pin/216 cps	599.00
P351	888.00
P351-C Color	999.00
P351 Model 2	949.00
T1100 & T3100	CALL

MONITORS
Princeton MAX-12 TTL	179.00
Samsung TTL IBM Green/Amber	88.00
TECO CGA Monitor	299.00
TECO EGA Monitor	399.00

AMDEK (2 Yr. Warranty)
Video 410A TTL/Amber	$166.00
Color 722 EGA Color Monitor	488.00

TAXAN
760 EGA Monitor 14"	$550.00
660 EGA Monitor 12"	540.00
560 EGA Card w/Autoswitch	299.00

ATI EGA Wonder	$289.00
GENOA Super EGA Card	$319.00
PARADISE Autoswitch EGA	$299.00
VIDEO 7 VEGA Deluxe EGA	$299.00

PGA SPECIALS
IBM/PGA Card	SALE $995.00

HARD DISKS
Filecard 20 Western Digital	$349.00
Filecard 30 Western Digital	499.00
10Mb Drive Only	149.00
21Mb XT Subsystem WD	339.00
21Mb XT Subsystem CMI/Tandon	319.00
21Mb XT Subsystem Seagate ST225	339.00
30Mb XT Subsystem Seagate ST238	499.00
30Mb AT Drive (40MS.) ST4038	469.00
40Mb AT Drive (40MS.) NEC 5046	599.00

CALL FOR HIGHER STORAGE DRIVES!

3-1/2" DRIVES HARD DISKS
20Mb 3-1/2" LaPine LT200	$299.00
30Mb 3-1/2" LaPine LT300	359.00

ALPHAMICRO
AlphaMicro VCR Backup Card	$333.00

FLOPPY DISK DRIVES
ACP IBM Drives DS	$ 69.00
Toshiba FDD4403 3-1/2" w/Kit	129.00
Toshiba ND04D PC/XT 360K	95.00
Toshiba ND04E-G AT 360K	105.00
Toshiba ND08DE-G 1.2Mb	129.00
TEAC FD-55B	99.00

DISKETTES (BOX OF 10)
DS/DD for PC/XT (40tpi)
- ACP Generic ..... $ 6.00
- Verbatim Datalife 9.95
- Maxell MD-2 ..... 9.95
- Fuji 9.95

DX/Hi-Density for AT (96tpi)
- Verbatim 19.95
- Maxell 19.95
- Fuji 19.95

SS/DD for Apple II/etc.
- Verbatim/Maxell/Fuji 7.95

Macintosh/IBM Conv. 3-1/2"
- Maxell Mf-2DD 19.95
- Fuji MF-2DD (135tpi) 19.95

MORE ACCESSORIES...

Flip-Soft (holds up to 75 disks)	14.00
ACP 5-1/4" Disk Holder	9.00
ACP 3-1/2" Disk Holder	12.00
Head Cleaner 5-1/4" or 8"	9.00
PERFECT COMPUTERCARE Kit	19.95

CLOSEOUTS! SUPPLY LIMITED!

Advanced XT	$499.00
SHARP PC5000 Laptop	199.00
3M DC100A Data Cartridge	12.85
3M DC300A Data Cartridge	14.85
Quadboard II w/64K	89.95
Orchid PC NET Blossom w/64K	195.00
Q&A IBM Software/New Vers.	219.00
6 Slot IBM Expansion Box	149.00
Data Prod. 8050C Color Printer	595.00
Persyst SB-III Multi-I/O	119.00
Persyst EG-8 EGA Card	99.00
Persyst Mono or Color Combo	99.95

Advanced Computer Products Inc.

TOLL FREE
800-854-8230
CA Residents 714-558-8813

OUR POLICY *Circle 6 on Reader Service Card*
- No Surcharge for VISA or Mastercard.
- Volume purchasing agreements available.
- Orders subject to availablity. • Supply limited on certain items.
- Pricing subject to change without notice.
- ACP Retail Store pricing may vary. Not responsible for typos.

Mail Order: P.O. Box 17329 Irvine, CA 92713
Retail: 1310 B E. Edinger, Santa Ana, CA 92705

CORPORATE BUYERS - CALL GILLES, DON, TODD, MIKE OR MARK

IC's

West Coast's Very Largest Selection!!!

If You don't see it here... Ask Us

IC's, Parts & Components • Fast Shipping

CO-PROCESSORS V20/30

8087 (5 MHz)	$105.00	V20-5	
8087-2 (8 MHz)	160.00	(5 MHz)	$9.95
80287 (5 MHz)	185.00	V20-8	
80287-8 (8 MHz)	265.00	(8 MHz)	12.95
8028710 (10 MHz)	365.00	V30-8 (8 MHz)	17.95

MOS EPROMS

1702A - 1ms	$5.95	27128 - 450ns	$4.95
2532 - 450ns	4.50	27256 - 200ns	7.95
2564 - 450ns	9.95	27C256 - 250ns	7.95
2708 - 450ns	4.25	27512 - 250ns	13.75
2716	4.95	8741	24.95
2716-1	5.95	8742	24.95
27C16	5.95	8748	16.95
TMS2716-450ns (3v)	8.49	8749	19.95
2732 - 450ns	3.95	8751	29.95
2732 - 250ns	4.95	68764	19.95
27C32	6.95	68766	19.95
2764 - 450ns	3.95	68701	24.95
2764 - 250ns	4.95	68705P	19.95
27C64 - 450ns	6.95	2816-EE	7.95
27128 - 250ns	5.95	2864-EE	19.95

Z80 SERIES

Z80CPU	$1.49	Z80ASIO/0	$4.95
Z80CTC	1.49	Z80ASIO/1	4.95
Z80DART	4.49	Z80ASIO/2	4.95
Z80PIO	1.49	Z80ADART	4.99
Z80ACPU	1.99	Z80BCPU	2.99
Z80ACTC	1.99	Z80BCTC	3.99
Z80APIO	1.99	Z80BPIO	3.99

BIPOLARS/PALS

82S123	$ 1.29	74S189	$1.69
82S126	1.29	74S287	1.99
82S129	1.99	74S288	1.99
82S137	2.99	74S471	4.99
82S181	7.99	74S472	6.99
82S191	11.99	PAL 16L8	4.99
74S188	1.29	PAL 20L8	9.95

8000 SERIES

8031	$ 2.95	8212	$1.95
8035/39	2.95	8216	1.95
8080A	2.95	8224	1.95
8085A	2.95	8237A/5	5.95
8086	7.50	8250	6.95
8088	7.95	8251A/5	1.95
8088-2	9.95	8253-5	1.95
80186-6 (5MHz)	14.95	8255-5	2.95
80186-3 (8MHz)	24.95	8257-5	2.95
80286-6 (5MHz)	19.95	8259-5	2.95
80286-8 (8MHz)	34.95	8272/765	4.25
80386 (12MHz)	450.00	8275	24.95
8202	11.95	8279	4.95
8203	14.95	8284	4.95

68000 SERIES

68000 - 8MHz	$12.95	68020 - 16MHz	$219.95
68010 - 8MHz	19.95	68450	49.95
68010 - 10MHz	39.95	68881 - 12MHz	219.95
68020 - 12MHz	149.95	68881 - 16MHz	299.95

6502 SERIES

6502	$2.95	6520	$2.95
65C02	11.95	6522	4.95
6502A	4.95	6532	4.95
6502B	6.95	6545	9.95
6510	9.95	6551	4.95

6800 SERIES

6800	$2.95	6821	$2.95
6802	4.95	6845	4.95
6810	2.95	6850	4.95

SPECIAL FUNCTION

VOICE RECOGNITION CHIP SET	$49.95	16450 - 16 BIT USART	$16.95
YAMAHA DXY CHIP SET	29.95	8250 - 8 BIT USART	6.95
TMS 6100 SPEECH CHIP	9.95	5832 - CLOCK	3.95
TMS 5200 SPEECH CHIP	7.95	58167 - CLOCK	8.95

CMOS

CD4001	$.18	CD4025	$.59	CD4063	$1.49	CD4512	$.69
CD4002	.18	CD4027	.35	CD4066	.29	CD4518	.79
CD4007	.59	CD4030	.29	CD4069	.29	CD4519	.79
CD4008	.59	CD4040	.65	CD4070	.29	CD4520	.79
CD4009	.59	CD4042	.65	CD4071	.29	CD4522	.79
CD4010	.29	CD4046	.65	CD4072	.29	CD4538	.79
CD4011	.29	CD4047	.65	CD4073	.79	CD4543	.89
CD4012	.29	CD4048	.75	CD4076	.65	CD4555	.99
CD4013	.29	CD4049	.29	CD4081	.29	CD4556	.99
CD4016	.59	CD4050	.39	CD4082	.29	CD4584	.69
CD4017	.59	CD4051	.39	CD4093	.35	CD14409	6.95
CD4018	.59	CD4052	.59	CD40103	1.90	CD14410	7.95
CD4020	.59	CD4053	.59	CD4510	.69	CD14411	8.95
CD4024	.49	CD4060	1.49	CD4511	.69	CD14412	8.95

7400 SERIES

7400	$.18	7432	$.25	74121	$.35	74175	$.65
7402	.18	7438	.25	74123	.45	74176	.65
7404	.18	7442	.30	74125	.45	74181	1.75
7405	.18	7446	.85	74126	.45	74189	2.95
7406	.35	7447	.95	74148	.65	74193	.65
7407	.35	7474	.35	74150	1.20	74195	.65
7408	.25	7475	.35	74151	.65	74198	1.65
7410	.25	7476	.35	74153	.65	74221	.75
7414	.35	7485	.35	74154	1.20	74273	1.75
7420	.25	7486	.35	74157	.65	74365	.50
7426	.25	7490	.35	74158	.65	74366	.50
7427	.25	7493	.35	74173	.65	74367	.50
7430	.25	7495	.35	74174	.65	74368	.50

74C CHIPS

74C00	$ .25	74C32	$.35	74C221	$1.25	74C906	$1.19
74C02	.25	74C90	1.19	74C240	1.69	74C912	6.95
74C04	.25	74C154	2.85	74C244	1.69	74C922	3.95
74C08	.35	74C173	.99	74C373	1.69	74C923	3.95
74C10	.35	74C174	.99	74C374	1.69	74C929	4.89
74C14	.49	74C175	.99	74C903	1.19	74C932	14.89

74LS SERIES

74LS00	$.19	74LS86	$.28	74LS166	$.99	74LS258	$.69
74LS02	.19	74LS90	.45	74LS173	.49	74LS259	.99
74LS03	.19	74LS93	.45	74LS174	.49	74LS273	.99
74LS04	.19	74LS107	.45	74LS175	.49	74LS322	1.79
74LS05	.19	74LS109	.45	74LS189	3.95	74LS323	1.79
74LS08	.19	74LS123	.49	74LS190	.49	74LS365	.59
74LS09	.19	74LS125	.45	74LS191	.49	74LS366	.59
74LS10	.19	74LS126	.49	74LS192	.49	74LS367	.59
74LS14	.35	74LS138	.45	74LS193	.49	74LS368	.99
74LS27	.28	74LS139	.45	74LS195	.49	74LS373	.99
74LS30	.25	74LS153	.59	74LS221	.65	74LS374	.99
74LS32	.28	74LS154	1.29	74LS240	.99	74LS393	.99
74LS47	.99	74LS157	.40	74LS241	.99	74LS624	1.89
74LS73	.35	74LS158	.40	74LS242	.99	74LS629	1.89
74LS74	.35	74LS161	.49	74LS243	.99	74LS640	1.89
74LS75	.35	74LS163	.49	74LS244	.99	74LS641	1.89
74LS76	.35	74LS164	.49	74LS245	.99	74LS670	.99
74LS85	.49	74LS165	.49	74LS257	.69	74LS688	1.89

74F SERIES

74F00	$.35	74F86	$.49	74F174	$.69	74F251	.79
74F02	.35	74F109	.49	74F175	.69	74F258	.79
74F04	.35	74F139	.49	74F181	1.99	74F280	2.89
74F08	.35	74F151	.59	74F189	2.99	74F373	1.49
74F10	.35	74F153	.59	74F219	4.99	74F374	1.49
74F11	.35	74F157	.59	74F240	1.29	74F379	1.99
74F20	.35	74F158	.59	74F241	1.29	74F399	2.99
74F32	.35	74F160	.59	74F243	1.29	74F521	2.99
74F64	.49	74F161	.59	74F244	1.29	74F533	2.99
74F74	.49	74F163	.59	74F245	$1.29	74F534	2.99

IC SOCKETS

SOLDERTAIL		HIREL		WIREWRAP		HIREL W/W	
8PINL/P	$.10	HR8S/T	$.39	8PINW/W	$.59	HR8W/W	$.79
14PINL/P	.12	HR14S/T	.49	14PINW/W	.59	HR14W/W	1.19
16PINL/P	.12	HR16S/T	.59	16PINW/W	.69	HR16W/W	1.29
18PINL/P	.16	HR18S/T	.69	18PINW/W	.99	HR18W/W	1.39
20PINL/P	.20	HR20S/T	.79	20PINW/W	1.19	HR20W/W	1.69
22PINL/P	.22	HR22S/T	.89	22PINW/W	1.29	HR22W/W	1.79
24PINL/P	.25	HR24S/T	.99	24PINW/W	1.29	HR24W/W	1.99
28PINL/P	.27	HR28S/T	1.19	28PINW/W	1.59	HR28W/W	2.29
40PINL/P	.29	HR40S/T	1.49	40PINW/W	1.99	HR40W/W	3.49
48PINL/P	.99	HR64S/T	4.99				
64PINL/P	2.49						

SAVE!

Partial Listing Only!!! Call us for components...

RAM UPGRADES SET OF 9

64K - 120ns	$12.95/set	256K - 120ns	$33.95/set
64K - 150ns	9.95/set	256K - 150ns	28.95/set
256K - 100ns	43.95/set	Call For Your Needs	

DYNAMIC RAMS

4116 - 200ns	$1.29	4464 - 150ns	$5.49
MK4332 - 200ns	5.95	41256 - 100ns	5.45
4164 - 200ns	1.10	41256 - 120ns	3.99
4164 - 150ns	1.19	41256 - 150ns	3.25
4164 - 120ns	1.49	41264 - 150ns	11.95
4164 - PIN ONE	2.75	4128 - 150ns	4.19
4416 - 200ns	3.75	8118/4517 -150ns	1.19
4416 - 150ns	4.19	1 MEG - 100ns	24.95
4464 - 120ns	6.49	TMS 4161-150ns	6.95

STATIC RAMS

2102LP - 450ns	$.99	6116 - 120ns	$2.95
2101 - 450ns	1.79	6116LP - 150ns	1.95
2112 - 450ns	2.69	6264LP - 120ns	3.95
2114 - 450ns	.89	6264LP - 150ns	3.65
21142	1.19	6264 - 150ns	3.50
2114L-2	1.99	62256 - 120ns	12.85
6116 - 150ns	1.95	62256 - 100ns	19.95

74HCT SERIES

74HCT00	$.25	74HCT161	$.65	74HCT540	$1.99		
74HCT02	.25	74HCT163	.65	74HCT541	1.99		
74HCT04	.25	74HCT164	.65	74HCT563	2.99		
74HCT08	.25	74HCT175	.65	74HCT564	2.99		
74HCT10	.25	74HCT240	1.29	74HCT573	1.99		
74HCT27	.30	74HCT241	1.29	74HCT574	1.99		
74HCT74	.49	74HCT244	1.29	74HCT640	1.99		
74HCT138	.50	74HCT245	1.29	74HCT646	2.99		
74HCT157	.65	74HCT257	.65	74HCT563	2.99		
74HCT160	.65	74HCT259	1.10	74HCT564	2.99		

LINEAR

TL074	$1.65	LM1330	$1.95
TL081	.75	LM1350	1.25
TL082	.85	LM1358	1.95
TL084	1.25	LM1372	2.25
LM301	.30	LM1408L8	2.50
LM309K	1.00	LM1458	.40
LM317K	2.95	LM1488	.60
LM317T	1.75	LM1489	.60
LM318	1.15	LM1889	2.50
LM319	.95	LM2003	.75
LM320T - XX	.60	LM2206	3.75
LM320K - XX	1.35	LM2211	2.75
LM323K	4.25	LM2240	1.75
LM324	.35	LM3130	.95
LM337K	4.95	LM3140	.95
LM338K	6.95	LM3160	1.95
LM340T - XX	.60	LM3161	1.95
LM340K - XX	1.35	LM3162	1.95
LM358	.45	LM3900	.45
LM380	.95	LM3909	1.25
LM386	.95	LM3911	1.95
LM393	.65	LM3914	2.75
LM497	2.50	LM3915	2.75
LM555	.30	LM3916	2.75
LM556	.45	LM4024	3.95
LM558	.85	LM4044	3.95
LM564	2.75	LM4136	1.50
LM565	1.50	LM4558	.75
LM566	1.10	LM7555	2.50
LM567	.75	LM7556	2.50
LM723	.30	LM7660	2.95
LM733	.30	LM7663	2.95
LM741	.30	LM78H05	6.95
LM747	.60	LM78H12	6.95
LM748	.65	LM8038	3.75

74HC SERIES

74HC00	$.25	74HC125	$.50	74HC174	$.65		
74HC02	.25	74HC132	.50	74HC175	.65		
74HC04	.25	74HC133	.50	74HC240	1.29		
74HC08	.25	74HC138	.55	74HC244	1.29		
74HC09	.25	74HC139	.55	74HC245	1.29		
74HC10	.25	74HC148	.75	74HC368	.65		
74HC11	.25	74HC151	.65	74HC373	1.29		
74HC14	.25	74HC153	.65	74HC374	1.29		
74HC20	.25	74HC154	3.75	74HC4020	.99		
74HC32	.25	74HC157	.65	74HC4060	1.99		
74HC74	.35	74HC161	.65	74HC4066	.99		
74HC85	.65	74HC166	1.15	74HC4075	.89		
74HC112	.65	74HC173	.65	74HC4078	1.49		

Advanced Computer Products Inc.

Large Quantities...Ask for Industrial Sales

TOLL FREE
800-854-8230
CA Residents 714-558-8813

OUR POLICY *Circle 6 on Reader Service Card*
- No Surcharge for VISA or Mastercard.
- Volume purchasing agreements available.
- Orders subject to availablity. • Supply limited on certain items.
- Pricing subject to change without notice.
- ACP Retail Store pricing may vary. Not responsible for typos.

Mail Order: P.O. Box 17329 Irvine, CA 92713
Retail: 1310 B E. Edinger, Santa Ana, CA 92705

CORPORATE BUYERS - CALL GILLES, DON, TODD, MIKE OR MARK

256K STATIC 150ns 32K x 8 $12.95 — 256K DRAMS 150ns 256K x 1 $2.95

STATIC RAMS / DYNAMIC RAMS

2101	256x4	(450ns)	1.95
2102L-4	1024x1	(450ns)(LowPower)	.99
2112	256x4	(450ns)	2.99
2114	1024x4	(450ns)	.99
2114L-4	1024x4	(450ns)(LP)	1.09
2114L-2	1024x4	(200ns)(LP)	1.49
2114L-15	1024x4	(150ns)(LP)	1.95
TMS4044-4	4096x1	(450ns)	1.95
TMM2016-150	2048x8	(150ns)	1.49
TMM2016-100	2048x8	(100ns)	1.95
HM6116-4	2048x8	(200ns)(CMOS)	1.79
HM6116-3	2048x8	(150ns)(CMOS)	1.85
HM6116LP-4	2048x8	(200ns)(CMOS)(LP)	1.85
HM6116LP-3	2048x8	(150ns)(CMOS)(LP)	1.90
HM6116LP-2	2048x8	(120ns)(CMOS)(LP)	2.45
HM6264P-15	8192x8	(150ns)(CMOS)	3.89
HM6264LP-15	8192x8	(150ns)(CMOS)(LP)	3.95
HM6264LP-12	8192x8	(120ns)(CMOS)(LP)	4.49
HM43256LP-15	32768x8	(150ns)(CMOS)(LP)	12.95
HM43256LP-12	32768x8	(120ns)(CMOS)(LP)	14.95
HM43256LP-10	32768x8	(100ns)(CMOS)(LP)	19.95
4116-250	16384x1	(250ns)	.49
4116-200	16384x1	(200ns)	.89
4116-150	16384x1	(150ns)	.99
4116-120	16384x1	(120ns)	1.49
MK4332	32768x1	(200ns)	6.95
4164-150	65536x1	(150ns)	1.29
4164-120	65536x1	(120ns)	1.55
MCM6665	65536x1	(200ns)	1.95
TMS4164	65536x1	(150ns)	1.95
4164-REFRESH	65536x1	(150ns)(PIN 1 REFRESH)	2.95
TMS4416	16384x4	(150ns)	3.75
41128-150	131072x1	(150ns)	5.95
TMS4464-15	65536x4	(150ns)	4.95
41256-150	262144x1	(150ns)	2.95
41256-120	262144x1	(120ns)	3.95
41256-100	262144x1	(100ns)	4.95
HM51258-100	262144x1	(100ns)(CMOS)	6.95
1 MB-120	1048576x1	(120ns)	19.95
1 MB-100	1048576x1	(100ns)	24.95

★★★★ HIGH-TECH ★★★★

80387 $495.00

- ★ 16 MEGAHERTZ MATH CO-PROCESSOR IN A PIN GRID ARRAY
- ★ FOR INTEL INBOARD AND OTHER 80386 BASED COMPUTERS
- ★ GET ALL THE SPEED AND POWER YOUR MACHINE CAN DELIVER
- ★ GREAT ADDITION FOR CAD, SPREADSHEET AND OTHER POWER PROGRAMS

★★★★ SPOTLIGHT ★★★★

U.S. AND CANADA ORDER TOLL FREE 800-538-5000

VISA MasterCard

EPROMS

2708	1024x8	(450ns)	4.95
2716	2048x8	(450ns)(5V)	3.49
2716-1	2048x8	(350ns)(5V)	3.95
TMS2532	4096x8	(450ns)(5V)	5.95
2732	4096x8	(450ns)(5V)	3.95
2732A	4096x8	(250ns)(5V)(21V PGM)	3.95
2732A-2	4096x8	(200ns)(5V)(21V PGM)	4.25
27C64	8192x8	(250ns)(5V)(CMOS)	4.95
2764	8192x8	(450ns)(5V)	3.49
2764-250	8192x8	(250ns)(5V)	3.69
2764-200	8192x8	(200ns)(5V)	4.25
MCM68766	8192x8	(350ns)(5V)(24 PIN)	15.95
27128	16384x8	(250ns)(5V)	4.25
27C256	32768x8	(250ns)(5V)(CMOS)	7.95
27256	32768x8	(250ns)(5V)	5.95
27512	65536x8	(250ns)(5V)	11.95
27C512	65536x8	(250ns)(5V)(CMOS)	12.95

5V=Single 5 Volt Supply — 21V PGM=Program at 21 Volts

SPECTRONICS CORPORATION EPROM ERASERS

Model	Timer	Capacity Chip	Intensity (uW/Cm²)	Unit Price
PE-14	NO	9	8,000	$83.00
PE-14T	YES	9	8,000	$119.00
PE-24T	YES	12	9,600	$175.00

8000

8035	1.49
8039	1.95
8052AH BASIC	34.95
8080	2.49
8085	1.95
8087 5MHz	99.00
8087-2 8MHz	159.95
8088	5.99
8088-2	7.95
8155	2.49
8748	7.95
8755	14.95
80286	79.95
80287 6MHz	179.95
80287-8 8MHz	249.95
80287-10 10MHz	309.95

8200

8205	3.29
8212	1.49
8216	1.49
8224	2.25
8237	3.95
8237-5	4.75
8250	6.95
8251	1.29
8251A	1.69
8253	1.59
8253-5	1.95
8255	1.49
8255-5	1.59
8259	1.95
8259-5	2.29
8272	4.39
8279	2.49
8279-5	2.95
8282	3.95
8284	2.25
8286	3.95
8288	4.95

Z-80

Z80-CPU 2.5 MHz 1.25

4.0 MHz

Z80A-CPU	1.29
Z80A-CTC	1.69
Z80A-DART	5.95
Z80A-DMA	5.95
Z80A-PIO	1.89
Z80A-SIO/0	5.95
Z80A-SIO/1	5.95
Z80A-SIO/2	5.95

6.0 MHz

Z80B-CPU	2.75
Z80B-CTC	4.25
Z80B-PIO	4.25
Z80B-DART	6.95
Z80B-SIO/0	12.95
Z80B-SIO/2	12.95
Z8671 ZILOG	9.95

V 20 SERIES

V20* 5 MHz	8.95
V20* 8 MHz	10.95
V30 8 MHz	13.95

*Replaces 8088 to speed up your PC by 10 to 40%

CRT CONTROLLERS

6845	2.95
68B45	4.95
6847	4.75
HD46505SP	6.95
MC1372	2.95
8275	16.95
7220	13.95
CRT5027	12.95
CRT5037	9.95
TMS9918A	19.95

DISK CONTROLLERS

1771	4.95
1791	9.95
1793	9.95
1795	12.95
1797	12.95
2791	19.95
2793	19.95
2797	29.95
8272	4.39
UPD765	4.39
MB8876	12.95
MB8877	12.95
1691	6.95
2143	6.95
9216	6.29

BIT RATE GENERATORS

MC14411	9.95
BR1941	4.95
4702	9.95
COM8116	8.95

UARTS

AY5-1013	3.95
AY3-1015	4.95
TR1602	3.95
2651	4.95
IM6402	3.95
IM6403	9.95
INS8250	6.95
NS16450	10.95

6500

1.0 MHz

6502	2.25
65C02 (CMOS)	7.95
6507	4.95
6520	1.65
6522	2.95
6526	13.95
6532	5.95
6545	2.95
6551	2.95
6561	19.95
6581	14.95

2.0 MHz

6502A	2.69
6520A	2.95
6522A	5.95
6532A	11.95
6545A	3.95
6551A	6.95

3.0 MHz

6502B	4.25

6800

1.0 MHz

6800	1.95
6802	2.95
6803	3.95
6809	2.95
6809E	2.95
6810	1.95
6820	2.95
6821	1.25
6840	3.95
6843	4.95
6844	6.95
6845	2.75
6847	4.75
6850	1.95
6883	22.95

2.0 MHz

68B00	2.95
68B02	3.95
68B09E	5.49
68B09	5.99
68B21	1.85
68B45	4.95
68B50	1.75
68B54	7.95

CLOCK CIRCUITS

MM5369	1.95
MM5369-EST	1.95
MM58167	9.95
MM58174	9.95
MSM5832	2.95

CRYSTALS

32.768 KHz	.95
1.0 MHz	2.95
1.8432	2.95
2.0	1.95
2.097152	1.95
2.4576	1.95
3.2768	1.95
3.579545	1.95
4.0	1.95
4.032	1.95
5.0	1.95
5.0688	1.95
6.0	1.95
6.144	1.95
6.5536	1.95
8.0	1.95
10.0	1.95
10.738635	1.95
12.0	1.95
14.31818	1.95
15.0	1.95
16.0	1.95
17.430	1.95
18.0	1.95
18.432	1.95
20.0	1.95
22.1184	1.95
24.0	1.95
32.0	1.95

CRYSTAL OSCILLATORS

1.0MHz	5.95
1.8432	5.95
2.0	5.95
2.4576	5.95
2.5	4.95
4.0	4.95
5.0688	4.95
6.0	4.95
6.144	4.95
8.0	4.95
10.0	4.95
12.0	4.95
12.480	4.95
15.0	4.95
16.0	4.95
18.432	4.95
20.0	4.95
24.0	4.95

MISC.

TMS99531	9.95
TMS99532	19.95
ULN2003	.79
3242	7.95
3341	4.95
MC3470	1.95
MC3480	8.95
MC3487	2.95
11C90	19.95
2513-001 UP	6.95
AY5-2376	11.95
AY5-3600 PRO	11.95

74LS00

74LS00	.16	74LS165	.65
74LS01	.18	74LS166	.95
74LS02	.17	74LS169	.95
74LS03	.18	74LS173	.49
74LS04	.16	74LS174	.39
74LS05	.18	74LS175	.39
74LS08	.18	74LS191	.49
74LS09	.18	74LS192	.69
74LS10	.16	74LS193	.69
74LS11	.22	74LS194	.69
74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
74LS14	.39	74LS197	.59
74LS15	.26	74LS221	.59
74LS20	.17	74LS240	.69
74LS21	.22	74LS241	.69
74LS22	.22	74LS242	.69
74LS27	.23	74LS243	.69
74LS28	.26	74LS244	.69
74LS30	.17	74LS245	.79
74LS32	.18	74LS251	.49
74LS33	.28	74LS253	.49
74LS37	.26	74LS256	1.79
74LS38	.26	74LS257	.39
74LS42	.39	74LS258	.49
74LS47	.75	74LS259	1.29
74LS48	.85	74LS260	.49
74LS51	.17	74LS266	.39
74LS73	.29	74LS273	.79
74LS74	.24	74LS279	.39
74LS75	.29	74LS280	1.98
74LS76	.29	74LS283	.59
74LS83	.49	74LS290	.89
74LS85	.49	74LS293	.89
74LS86	.22	74LS299	1.49
74LS90	.39	74LS322	3.95
74LS92	.49	74LS323	2.49
74LS93	.39	74LS364	1.95
74LS95	.49	74LS365	.39
74LS107	.34	74LS367	.39
74LS109	.36	74LS368	.39
74LS112	.29	74LS373	.79
74LS122	.45	74LS374	.79
74LS123	.49	74LS375	.95
74LS124	2.75	74LS377	.79
74LS125	.39	74LS378	1.18
74LS126	.39	74LS390	1.19
74LS132	.39	74LS393	.79
74LS133	.49	74LS541	1.49
74LS136	.39	74LS624	1.95
74LS138	.39	74LS640	.99
74LS139	.39	74LS645	.99
74LS145	.99	74LS669	1.29
74LS147	.99	74LS670	.89
74LS148	.99	74LS682	3.20
74LS151	.39	74LS683	3.20
74LS153	.39	74LS684	3.20
74LS154	1.49	74LS688	2.40
74LS155	.59	74LS783	22.95
74LS156	.49	81LS95	1.49
74LS157	.35	81LS96	1.49
74LS158	.29	81LS97	1.49
74LS160	.29	81LS98	1.49
74LS161	.39	25LS2521	2.80
74LS162	.49	25LS2569	2.80
74LS163	.39	26LS31	1.95
74LS164	.49	26LS32	1.95

HIGH SPEED CMOS

A new family of high speed CMOS logic featuring the speed of low power Schottky (8ns typical gate propagation delay), combined with the advantages of CMOS: very low power consumption, superior noise immunity, and improved output drive.

74HC00

74HC: Operate at CMOS logic levels and are ideal for new, all-CMOS designs.

74HC00	.21	74HC148	.79
74HC02	.21	74HC151	.59
74HC04	.25	74HC154	1.09
74HC08	.25	74HC157	.55
74HC10	.25	74HC158	.55
74HC14	.35	74HC163	.65
74HC20	.25	74HC175	.59
74HC27	.25	74HC240	.85
74HC30	.25	74HC244	.85
74HC32	.35	74HC245	.85
74HC51	.25	74HC257	.55
74HC74	.35	74HC259	.55
74HC85	.55	74HC273	.69
74HC86	.45	74HC299	1.29
74HC93	.99	74HC368	.68
74HC107	.39	74HC373	.69
74HC109	.39	74HC374	.69
74HC112	.39	74HC390	.79
74HC125	.55	74HC393	.69
74HC132	.49	74HC4017	.99
74HC133	.39	74HC4020	.89
74HC138	.45	74HC4049	.69
74HC139	.45	74HC4050	.59

74HCT00

74HCT: Direct, drop-in replacements for LS TTL and can be intermixed with 74LS in the same circuit.

74HCT00	.25	74HCT166	1.39
74HCT02	.25	74HCT174	.59
74HCT04	.27	74HCT193	.85
74HCT08	.25	74HCT194	.85
74HCT10	.25	74HCT240	.89
74HCT11	.27	74HCT241	.79
74HCT27	.29	74HCT244	.89
74HCT30	.25	74HCT245	.99
74HCT32	.27	74HCT257	.79
74HCT74	.45	74HCT259	.89
74HCT75	.45	74HCT273	.99
74HCT138	.55	74HCT367	.79
74HCT139	.55	74HCT373	.99
74HCT154	1.95	74HCT374	.99
74HCT157	.59	74HCT393	.99
74HCT158	.69	74HCT4017	1.19
74HCT161	.79	74HCT4040	.99
74HCT164	.79	74HCT4060	1.49

74F00

74F00	.35	74F74	.39	74F251	.89
74F02	.35	74F86	.55	74F253	.89
74F04	.35	74F138	.79	74F257	.89
74F08	.35	74F139	.79	74F280	1.29
74F10	.35	74F157	.89	74F283	2.95
74F32	.35	74F240	1.29	74F373	1.35
74F64	.55	74F244	1.29	74F374	1.35

NEW STORE HOURS! M-F: 9-7, SAT: 9-5 & SUN: 12-4

Visit our retail store located at 1256 S. Bascom Ave. in San Jose, (408) 947-8881

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

JDR Microdevices

110 Knowles Drive, Los Gatos, CA 95030

Toll Free 800-538-5000 • (408) 866-6200

FAX (408) 378-8927 • Telex 171-110

TERMS: Minimum order $10.00. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges—please contact our sales department for the amount. CA. residents must include applicable sales tax. All merchandise is warranted for 90 days unless otherwise stated. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale. A full copy of our terms is available upon request. Items pictured may only be representative.

PRICES SLASHED! DB25 MALE D-SUB 69¢

CMOS

4001	.19	14419	4.95
4011	.19	14433	14.95
4012	.25	14497	6.95
4013	.35	4503	.49
4015	.29	4511	.69
4016	.29	4516	.79
4017	.49	4518	.85
4018	.69	4522	.79
4020	.59	4526	.79
4021	.69	4527	1.95
4024	.49	4528	.79
4025	.25	4529	2.95
4027	.39	4532	1.95
4028	.65	4538	.95
4035	.69	4541	1.29
4040	.69	4553	5.79
4041	.75	4585	.75
4042	.59	4702	12.95
4043	.85	74C00	.29
4044	.69	74C14	.59
4045	1.98	74C74	.59
4046	.69	74C83	1.95
4047	.69	74C85	1.49
4049	.29	74C95	.99
4050	.29	74C150	5.75
4051	.69	74C151	2.25
4052	.69	74C161	.99
4053	.69	74C163	.99
4056	2.19	74C164	1.39
4060	.69	74C192	1.49
4066	.29	74C193	1.49
4069	.19	74C221	2.49
4076	.59	74C240	1.89
4077	.29	74C244	1.89
4081	.22	74C374	1.99
4085	.79	74C905	10.95
4086	.89	74C911	8.95
4093	.49	74C917	12.95
4094	2.49	74C922	4.49
14411	9.95	74C923	4.95
14412	6.95	74C926	7.95

7400/9000

7400	.19	74147	2.49
7402	.19	74148	1.20
7404	.19	74150	1.35
7406	.29	74151	.55
7407	.29	74153	.55
7408	.24	74154	1.49
7410	.19	74155	.75
7411	.25	74157	.55
7414	.49	74159	1.65
7416	.25	74161	.69
7417	.25	74163	.69
7420	.19	74164	.85
7423	.29	74165	.85
7430	.19	74166	1.00
7432	.29	74175	.89
7438	.29	74177	.75
7442	.49	74178	1.15
7445	.69	74181	2.25
7447	.89	74182	.75
7470	.35	74184	2.00
7473	.34	74191	1.15
7474	.33	74192	.79
7475	.45	74194	.85
7476	.35	74196	.79
7483	.50	74197	.75
7485	.59	74199	1.35
7486	.35	74221	1.35
7489	2.15	74246	1.35
7490	.39	74247	1.25
7492	.50	74248	1.85
7493	.35	74249	1.95
7495	.55	74251	.75
7497	2.75	74265	1.35
74100	2.29	74273	1.95
74121	.29	74278	3.11
74123	.49	74367	.65
74125	.45	74368	.65
74141	.65	9368	2.85
74143	5.95	9602	.69
74144	2.95	9637	2.95
74145	.60	96S02	1.95

74S00

74S00	.29	74S163	1.29
74S02	.29	74S168	3.95
74S03	.29	74S174	.79
74S04	.29	74S175	.79
74S05	.29	74S188	1.95
74S08	.35	74S189	1.95
74S10	.29	74S195	1.49
74S15	.49	74S196	2.49
74S30	.29	74S197	2.95
74S32	.35	74S226	3.99
74S37	.69	74S240	1.49
74S38	.69	74S241	1.49
74S74	.49	74S244	1.49
74S85	.95	74S257	.79
74S86	.35	74S253	.79
74S112	.50	74S258	.95
74S124	2.75	74S280	1.95
74S138	.79	74S287	1.69
74S140	.55	74S288	1.69
74S151	.79	74S299	2.95
74S153	.79	74S373	1.69
74S157	.79	74S374	1.69
74S158	.95	74S471	4.95
74S161	1.29	74S571	2.95

VOLTAGE REGULATORS

TO-220 CASE

7805T	.49	7905T	.59
7808T	.49	7908T	.59
7812T	.49	7912T	.59
7815T	.49	7915T	.59

TO-3 CASE

7805K	1.59	7905K	1.69
7812K	1.39	7912K	1.49

TO-93 CASE

78L05	.49	79L05	.69
78L12	.49	79L12	1.49

OTHER VOLTAGE REGS

LM323K	5V 3A TO-3		4.79
LM338K	Adj. 5A TO-3		6.95

IC SOCKETS

	1-99	100+
8 PIN ST	.11	.10
14 PIN ST	.11	.09
16 PIN ST	.12	.10
18 PIN ST	.15	.13
20 PIN ST	.18	.15
22 PIN ST	.15	.12
24 PIN ST	.20	.15
28 PIN ST	.22	.16
40 PIN ST	.30	.22
64 PIN ST	1.95	1.49

ST=SOLDERTAIL

8 PIN WW	.59	.69
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80

WW=WIREWRAP

16 PIN ZIF	4.95	CALL
24 PIN ZIF	5.95	CALL
28 PIN ZIF	6.95	CALL
40 PIN ZIF	9.95	CALL

ZIF=TEXTOOL
(ZERO INSERTION FORCE)

LINEAR

TL066	.99	LM733	.98
TL071	.69	LM741	.29
TL072	1.09	LM747	.69
TL074	1.95	LM748	.59
TL081	.59	MC1330	1.69
TL082	.99	MC1350	1.19
TL084	1.49	MC1372	6.95
LM301	.34	LM1414	1.59
LM309K	1.25	LM1458	.35
LM311	.59	LM1488	.49
LM311H	.89	LM1489	.49
LM317K	3.49	LM1496	.85
LM317T	.69	LM1812	8.25
LM318	1.49	LM1889	1.95
LM319	1.25	ULN2003	.79
LM320 see7900		XR2206	3.95
LM322	1.95	XR2211	2.95
LM323K	3.49	XR2240	1.95
LM324	.34	MPQ2907	1.95
LM331	3.95	LM2917	1.95
LM334	1.19	CA3046	.89
LM335	1.79	CA3081	.99
LM336	1.75	CA3082	.99
LM337K	3.95	CA3086	.80
LM338K	4.49	CA3130E	.99
LM339	.59	CA3146	1.29
LM340 see7800		CA3160	1.19
LM350T	4.60	MC3373	1.29
LF353	.59	MC3470	1.95
LF356	.99	MC3480	8.95
LF357	.99	MC3487	2.95
LM358	.59	LM3900	.49
LM380	.89	LM3909	.98
LM383	1.95	LM3911	2.25
LM386	.89	LM3914	1.89
LM393	.45	MC4024	3.49
LM394H	5.95	MC4044	3.99
TL494	4.20	RC4136	1.25
TL497	3.25	RC4558	.69
NE555	.29	LM13600	1.49
NE556	.49	75107	1.49
NE558	.79	75110	1.95
NE564	1.95	75150	1.95
LM565	.95	75154	1.95
LM566	1.49	75188	1.25
LM567	.79	75189	1.25
NE570	2.95	75451	.39
NE590	2.50	75452	.39
NE592	.98	75453	.39
LM710	.75	75477	1.29
LM723	.49	75492	.79

H=TO-5 CAN, K=TO-3, T=TO-220

EDGECARD CONNECTORS

100	PIN ST	S-100	.125	3.95
100	PIN WW	S-100	.125	4.95
62	PIN ST	IBM PC	.100	1.95
50	PIN ST	APPLE	.100	2.95
44	PIN ST	STD	.156	1.95
44	PIN WW	STD	.156	4.95

36 PIN CENTRONICS

MALE

IDCEN36	RIBBON CABLE	3.95
CEN36	SOLDER CUP	1.85

FEMALE

IDCEN36/F	RIBBON CABLE	4.95
CEN36PC	RT ANGLE PC MOUNT	4.95

DATA ACQ INTERFACE

ADC0800	12.95	8T26	1.29
ADC0804	2.99	8T28	1.29
ADC0809	3.85	8T95	.89
ADC0816	14.95	8T96	.89
ADC0817	8.49	8T97	.59
ADC0831	4.49	8T98	.89
DAC0800	3.29	DM8131	2.95
DAC0806	3.29	DP8304	2.29
DAC0808	1.95	DS8833	2.25
DAC1020	6.85	DS8835	1.99
DAC1022	5.95	DS8836	.99
MC1408L8	1.95	DS8837	1.65

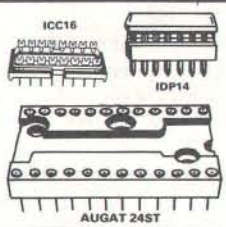
INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	1.99
ICL8038	4.95
ICM7207A	5.95
ICM7208	15.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS								
		8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.62	.79	.89	1.09	1.29	1.39	1.49	1.69	2.49
HIGH RELIABILITY TOOLED WW IC SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40
COMPONENT CARRIES (DIP HEADERS)	ICCxx	.49	.59	.69	.99	.99	.99	.99	1.09	1.49
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	---	.49	.59	---	---	---	.85	---	1.59

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE BELOW



DIODES/OPTO/TRANSISTORS

1N751	.15	4N26	.69
1N759	.15	4N27	.69
1N4148	25/1.00	4N28	.69
1N4004	10/1.00	4N33	.89
1N5402	.25	4N37	1.19
KBP02	.55	MCT-2	.59
KBU8A	.95	MCT-6	1.29
MDA990-2	.35	TIL-111	2.25
N2222	.25	2N3906	.10
PN2222	.10	2N4401	.25
2N2905	.50	2N4402	.25
2N2907	.25	2N4403	.25
2N3055	.79	2N6045	1.75
2N3904	.10	TIP31	.49

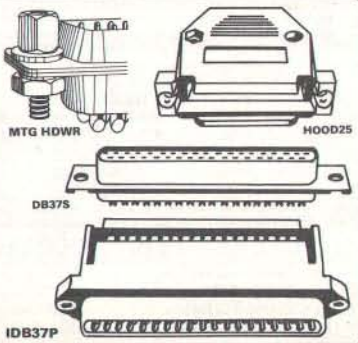
D-SUBMINIATURE

DESCRIPTION		ORDER BY	CONTACTS					
			9	15	19	25	37	50
SOLDER CUP	MALE	DBxxP	.45	.59	.69	.69	1.35	1.85
	FEMALE	DBxxS	.49	.69	.75	.75	1.39	2.29
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	.49	.69	---	.79	2.27	---
	FEMALE	DBxxSR	.55	.75	---	.85	2.49	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	---	3.89	5.60	---
	FEMALE	DBxxSWW	2.76	4.27	---	6.84	9.95	---
IDC RIBBON CABLE	MALE	IDBxxP	1.39	1.99	---	2.25	4.25	---
	FEMALE	IDBxxS	1.45	2.05	---	2.35	4.49	---
HOODS	METAL	MHOODxx	1.05	1.15	1.25	1.25	---	---
	GREY	HOODxx	.39	.39	---	.39	.69	.75

ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED.

EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15PR.

MOUNTING HARDWARE 59¢



LED DISPLAYS

FND-357(359)	COM CATHODE	.362"	1.25
FND-500(503)	COM CATHODE	.5"	1.49
FND-507(510)	COM ANODE	.5"	1.49
MAN-72	COM ANODE	.3"	.99
MAN-74	COM CATHODE	.3"	.99
TIL-313	COM CATHODE	.3"	.45
TIL-311	4x7 HEX W/LOGIC	.270"	9.95

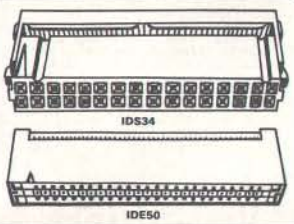
DIFFUSED LEDS

		1-99	100-UP
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.14	.12
JUMBO YELLOW	T1¾	.14	.12
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09

IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS					
		10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	.63	.89	.95	1.29	1.49	1.69
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	.85	1.25	1.35	1.75	2.05	2.45

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE ABOVE



SWITCHES

SPDT	MINI-TOGGLE ON-ON	1.25
DPDT	MINI-TOGGLE ON-ON	1.50
DPDT	MINI-TOGGLE ON-OFF-ON	1.75
SPST	MINI-PUSHBUTTON N.O.	.39
SPST	MINI-PUSHBUTTON N.C.	.39
BCD OUTPUT 10 POSITION 6 PIN DIP		1.95

DIP SWITCHES

4 POSITION	.85	7 POSITION	.95
5 POSITION	.90	8 POSITION	.95
6 POSITION	.90	10 POSITION	1.29

RIBBON CABLE

CONTACTS	SINGLE COLOR		COLOR CODED	
	1'	10'	1'	10'
10	.18	1.60	.30	2.75
16	.28	2.50	.48	4.40
20	.36	3.20	.60	5.50
25	.45	4.00	.75	6.85
26	.46	4.10	.78	7.15
34	.55	5.40	1.07	9.35
40	.72	6.40	1.20	11.00
50	.89	7.50	1.50	13.25

HARD TO FIND "SNAPABLE" HEADERS

CAN BE SNAPPED APART TO MAKE ANY SIZE HEADER, ALL WITH .1" CENTERS

1x40	STRAIGHT LEAD	.99
1x40	RIGHT ANGLE	1.49
2x40	STRAIGHT LEAD	2.49
2x40	RIGHT ANGLE	2.99

SHORTING BLOCKS

GOLD CONTACTS SPACED AT .1" CENTERS

5/$1.00

WHY THOUSANDS CHOOSE JDR

- ★ QUALITY MERCHANDISE, COMPETITIVE PRICES
- ★ MOST ORDERS SHIPPED WITHIN 24 HOURS
- ★ FRIENDLY, KNOWLEDGEABLE STAFF
- ★ MONEY BACK GUARANTEE (ASK FOR DETAILS)
- ★ TOLL FREE TECHNICAL SUPPORT
- ★ EXCELLENT CUSTOMER SERVICE

CALL FOR VOLUME QUOTES

PRICES SLASHED! AT PROTOTYPE BOARD $29.95

BARGAIN HUNTERS CORNER

HYUNDAI MONOCHROME MONITOR

- ★ 12" NON-GLARE AMBER SCREEN
- ★ IBM COMPATIBLE TTL INPUT
- ★ ATTRACTIVE CASE WITH TILT & SWIVEL BASE

ONLY $69.95

SPECIAL ENDS 10/31/87

PAGE WIRE WRAP WIRE
PRECUT ASSORTMENT
IN ASSORTED COLORS $27.50

100ea: 5.5", 6.0", 6.5", 7.0"
250ea: 2.5", 4.5", 5.0"
500ea: 3.0", 3.5", 4.0"

SPOOLS

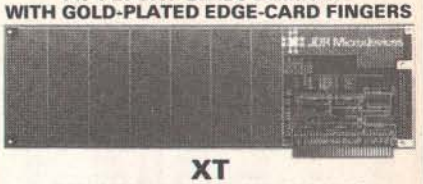
100 feet	$4.30	250 feet	$7.25
500 feet	$13.25	1000 feet	$21.95

Please specify color:
Blue, Black, Yellow or Red

EXTENDER CARDS

IBM-PC $29.95
IBM-AT $39.95

WIRE WRAP PROTOTYPE CARDS
FR-4 EPOXY GLASS LAMINATE
WITH GOLD-PLATED EDGE-CARD FINGERS



XT

BOTH CARDS HAVE SILK SCREENED LEGENDS AND INCLUDES MOUNTING BRACKET

IBM-PR1	WITH +5V AND GROUND PLANE	$27.95
IBM-PR2	AS ABOVE W/DECODING LAYOUT	$29.95

AT

IBM-PRAT	LARGE +5V & GROUND PLANES	$29.95

S-100

P100-1	BARE - NO FOIL PADS	$15.15
P100-2	HORIZONTAL BUS	$21.80
P100-3	VERTICAL BUS	$21.80
P100-4	SINGLE FOIL PADS PER HOLE	$22.75

APPLE

P500-1	BARE - NO FOIL PADS	$15.15
P500-3	HORIZONTAL BUS	$22.75
P500-4	SINGLE FOIL PADS PER HOLE	$21.80
7060-45	FOR APPLE IIe AUX SLOT	$30.00

SOCKET-WRAP I.D.™

- * SLIPS OVER WIRE WRAP PINS
- * IDENTIFIES PIN NUMBERS ON WRAP SIDE OF BOARD
- * CAN WRITE ON PLASTIC; SUCH AS IC #

PINS	PART#	PCK. OF	PRICE
8	IDWRAP 08	10	1.95
14	IDWRAP 14	10	1.95
16	IDWRAP 16	10	1.95
18	IDWRAP 18	5	1.95
20	IDWRAP 20	5	1.95
22	IDWRAP 22	5	1.95
24	IDWRAP 24	5	1.95
28	IDWRAP 28	5	1.95
40	IDWRAP 40	5	1.95

PLEASE ORDER BY NUMBER OF PACKAGES (PCK. OF)

ID WRAP 24

FRAME STYLE TRANSFORMERS

12.6V AC CT	2 AMP	5.95
12.6V AC CT	4 AMP	7.95
12.6V AC CT	8 AMP	10.95
25.2V AC CT	2 AMP	7.95

25 PIN D-SUB GENDER CHANGERS $7.95

SWITCHING POWER SUPPLIES

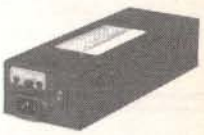
PS-IBM $59.95
- * FOR IBM PC-XT COMPATIBLE
- * 135 WATTS
- * +5V @ 15A, +12V @ 4.2A -5V @ .5A, -12V @ .5A
- * ONE YEAR WARRANTY

PS-IBM/150

PS-IBM-150 $69.95
- * FOR IBM PC-XT COMPATIBLE
- * 150 WATTS
- * +12V @ 5.2A, +5V @ 16A -12V @ .5A, -5V @ .5A
- * ONE YEAR WARRANTY

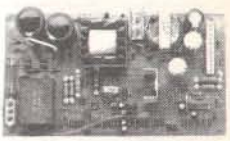
PS-AT $89.95
- * FOR IBM PC-AT COMPATIBLE
- * 220 WATTS
- * +5V @ 22A, +12V @ 8A -5V @ .5A, -12V @ .5A
- * 1 YEAR WARRANTY

PS-AT



PS-A $49.95
- * USE TO POWER APPLE TYPE SYSTEMS, 79.5 WATTS
- * +5V @ 7A, +12V @ 3A -5V @ .5A, -12V @ .5A
- * APPLE POWER CONNECTOR

PS-A



PS-1558 $34.95
- * 75 WATTS, UL APPROVED
- * +5V @ 7A, +12V @ 3A -12V @ 250ma, -5V @ 300ma

PS-1558

CAPACITORS

TANTALUM

1.0µf	15V	.12	.47µf	35V	.39
6.8	15V	.42	1.0	35V	.45
10	15V	.45	2.2	35V	.19
22	15V	.99	4.7	35V	.39
.22	35V	.15	10	35V	.69

DISC

10pf	50V	.05	680	50V	.05
22	50V	.05	.001µf	50V	.05
27	50V	.05	.0022	50V	.05
33	50V	.05	.005	50V	.05
47	50V	.05	.01	50V	.07
68	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10
560	50V	.05	.1	50V	.12

MONOLITHIC

.01µf	50V	.14	.1µf	50V	.18
.047µf	50V	.15	.47µf	50V	.25

ELECTROLYTIC

	RADIAL			AXIAL	
1µf	25V	.14	1µf	50V	.14
2.2	35V	.11	10	50V	.16
4.7	50V	.11	22	16V	.14
10	50V	.11	47	50V	.19
47	35V	.13	100	35V	.19
100	16V	.15	220	25V	.25
220	35V	.20	470	50V	.29
470	25V	.30	1000	16V	.29
2200	16V	.70	2200	16V	.70
4700	25V	1.45	4700	16V	1.25

DATARASE EPROM ERASER $34.95

- * ERASES 2 IN 10 MINUTES
- * COMPACT-NO DRAWER
- * THIN METAL SHUTTER PREVENTS UV LIGHT FROM ESCAPING

1/4 WATT RESISTORS

5% CARBON FILM ALL STANDARD VALUES FROM 1 OHM TO 10 MEG. OHM

10 PCS	same value .05	100 PCS	same value .02
50 PCS	same value .025	1000 PCS	same value .015

RESISTOR NETWORKS

SIP	10 PIN	9 RESISTOR	.69
SIP	8 PIN	7 RESISTOR	.59
DIP	16 PIN	8 RESISTOR	1.09
DIP	16 PIN	15 RESISTOR	1.09
DIP	14 PIN	7 RESISTOR	.99
DIP	14 PIN	13 RESISTOR	.99

SPECIALS ON BYPASS CAPACITORS

.01 µf CERAMIC DISC	100/$5.00
.01 µf MONOLITHIC	100/$10.00
.1 µf CERAMIC DISC	100/$6.50
.1 µf MONOLITHIC	100/$12.50

BOOKS BY STEVE CIARCIA

BIULD YOUR OWN Z80 COMPUTER	$19.95
CIRCUIT CELLAR VOL 1	$17.95
CIRCUIT CELLAR VOL 2	$18.95
CIRCUIT CELLAR VOL 3	$18.95
CIRCUIT CELLAR VOL 4	$18.95
CIRCUIT CELLAR VOL 5	$19.95

MUFFIN FANS

3.15" SQ. 14.95 3.63" SQ. 14.95
3.18" SQUARE 16.95

6' LINE CORDS

2 conductor .39 3 conductor .99
3 conductor w/female socket 1.49

EMI FILTER $4.95

WISH SOLDERLESS BREADBOARDS

PART NUMBER	DIMENSIONS	DISTRIBUTION STRIP(S)	TIE POINTS	TERMINAL STRIP(S)	TIE POINTS	BINDING POSTS	PRICE
WBU-D	.38 x 6.50"	1	100	---	---	---	2.95
WBU-T	1.38 x 6.50"	---	---	1	630	---	6.95
WBU-204-3	3.94 x 8.45"	1	100	2	1260	2	17.95
WBU-204	5.13 x 8.45"	4	400	2	1260	3	24.95
WBU-206	6.88 x 9.06"	5	500	3	1890	4	29.95
WBU-208	8.25 x 9.45"	7	700	4	2520	4	39.95

WBU-208

LITHIUM BATTERY
AS USED IN CLOCK CIRCUITS

3 VOLT BATTERY $1.95
BATTERY HOLDER $1.49

2 VOLUME SET IC MASTER
THE INDUSTRY STANDARD
$129.95

NEW STORE HOURS! M-F: 9-7, SAT: 9-5 & SUN: 12-4

Visit our retail store located at 1256 S. Bascom Ave. in San Jose, (408) 947-8881

JDR Microdevices

110 Knowles Drive, Los Gatos, CA 95030
Toll Free 800-538-5000 • (408) 866-6200
FAX (408) 378-8927 • Telex 171-110

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order $10.00. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges—please contact our sales department for the amount. CA. residents must include applicable sales tax. All merchandise is warranted for 90 days unless otherwise stated. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale. A full copy of our terms is available upon request. Items pictured may only be representative.

Circle 139 on Reader Service Card

20 MEG HARD DISK DRIVE ON A CARD $349!

MONITOR STANDS

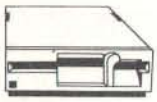
MODEL MS-100 $12.95

- TILTS AND SWIVELS
- STURDY ABS PLASTIC CONSTRUCTION

MODEL MS-200 $39.95

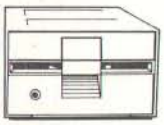
- TILTS AND SWIVELS
- BUILT-IN POWER STATION INDEPENDANTLY CONTROLS UP TO 5 120 VOLT AC OUTLETS
- BUILT-IN SURGE SUPRESSOR
- UL APPROVED

DISK DRIVES
FOR APPLE COMPUTERS



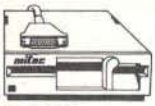
AP-150 $99.95

- ½ HT, DIRECT DRIVE
- 100% APPLE COMPATIBLE
- SIX MONTH WARRANTY



AP-135 $129.95

- FULL HT SHUGART MECHANISM
- DIRECT REPLACEMENT FOR APPLE DISK II
- SIX MONTH WARRANTY



AD-3C $139.95

- 100% APPLE IIc COMPATIBLE, READY TO PLUG IN, W/SHIELDED CABLE & MOLDED 19 PIN CONNECTOR
- FAST, RELIABLE SLIMLINE DIRECT DRIVE
- SIX MONTH WARRANTY

DISK DRIVE ACCESSORIES

FDD CONTROLLER CARD	$49.95
IIc ADAPTOR CABLE	$19.95

ADAPTS STANDARD APPLE DRIVES FOR USE WITH APPLE IIc

KB-1000 $79.95

CASE WITH KEYBOARD FOR APPLE TYPE MOTHERBOARD

- USER DEFINED FUNCTION KEYS
- NUMERIC KEYPAD W/ CURSOR CONTROL
- CAPS LOCK
- AUTO-REPEAT

JOYSTICK GC-10 $19.95

- SET X-Y AXIS FOR AUTO CENTER OR FREE MOVEMENT
- FIRE BUTTON FOR USE WITH GAME SOFTWARE
- ATTRACTIVE, SOLID, PLASTIC CASE
- INCLUDES ADAPTOR CABLE FOR IBM, APPLE II, IIe

CRT MONITORS FOR ALL APPLICATIONS

CASPER EGA MONITOR

- EGA & CGA COMPATIBLE
- SCANNING FREQUENCIES: 15.75 / 21.85 KHz
- RES: 640 x 200 / 350
- .31mm DOT PITCH, 25 MHz
- 16 COLORS OUT OF 64
- 14", BLACK MATRIX SCREEN

$399.95

CASPER RGB MONITOR

- COLOR/GREEN/AMBER SWITCH ON REAR
- DIGITAL RGB-IBM COMPATIBLE
- 14" NON-GLARE SCREEN
- RESOLUTION: 640H x 240V
- .39mm DOT PITCH
- CABLE FOR IBM PC INCLUDED

$279.95

FORTRONICS MONOCHROME

- IBM COMPATIBLE TTL INPUT
- 12" NON-GLARE SCREEN
- VERY HIGH RESOLUTION: 1100 LINES (CENTER)
- 25 MHz BANDWIDTH
- CABLE FOR IBM PC INCLUDED

AMBER OR GREEN AVAILABLE

$99.95

SOLDER STATION

JDR PART #: 168-2C

- FULLY ADJUSTABLE HEAT SETTING WITH TIP TEMPERATURE READOUT
- QUICK HEATING AND RECOVERY
- VARIETY OF REPLACEMENT TIPS ARE AVAILABLE
- RANGE: 200°-900°F
- UL APPROVED

$49.95

APPLE COMPATIBLE INTERFACE CARDS

EPROM PROGRAMMER

- DUPLICATE OR BURN ANY 27xx SERIES EPROM (2716 TO 27128)
- MENU-DRIVEN SOFTWARE
- HIGH SPEED WRITE ALGORITHM

RP-525 $59.95

16K RAMCARD

- FULL 2 YEAR WARRANTY
- EXPAND YOUR 48K MACHINE TO A FULL 64K OF MEMORY
- CAN BE USED IN PLACE OF THE APPLE LANGUAGE CARD

RAM-CARD $39.95

IC TEST CARD

- QUICKLY TESTS MANY COMMON ICs
- DISPLAYS PASS OR FAIL
- TEST 4000 & 74HC SERIES CMOS, 7400, 74LS, 74L, 74H & 74S

IC-TESTER $129.95

20 MEGABYTE HARD DISK CARD

- SAVES SPACE AND REDUCES POWER CONSUMPTION
- IDEAL FOR PCs WITH FULL HEIGHT FLOPPIES
- LEAVES ROOM FOR A HALF LENGTH CARD IN ADJACENT SLOT

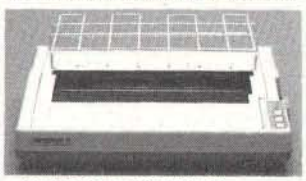
NOW $349

MOLDED INTERFACE CABLES

6 FOOT, 100% SHIELDED, MEETS FCC

IBM PARALLEL PRINTER CABLE	9.95
CENTRONICS (MALE TO FEMALE)	15.95
CENTRONICS (MALE TO MALE)	14.95
MODEM CABLE (FOR IBM)	7.95
RS232 SERIAL (MALE TO FEMALE)	9.95
RS232 SERIAL (MALE TO MALE)	9.95
KEYBOARD EXTENDER (COILED)	7.95
APPLE II JOYSTICK EXTENDER	4.95

C. ITOH RITEMAN II PRINTER



- 160 CPS DRAFT, 32 CPS NLQ
- 9 x 9 DOT MATRIX
- SUPPORTS EPSON/IBM GRAPHICS
- FRICTION AND PIN FEEDS
- VARIABLE LINE SPACING AND PITCH

$219.95

IBM PRINTER CABLE	$9.95
REPLACEMENT RIBBON CARTRIDGE	$7.95

Seagate 5¼" HARD DISK DRIVES

ST-225	HALF HT 20MB 65ms	$275
ST-238	HALF HT 30MB 65ms (RLL)	$299
ST-251	HALF HT 40MB 40ms	$469
ST-277	HALF HT 60MB 40ms (RLL)	$649
ST-4038	FULL HT 30MB 40ms	$559
ST-4096	FULL HT 80MB 28ms	$1195

½ HEIGHT FLOPPY DISK DRIVES

5¼" TEAC FD-55B DS/DD	$109.95
5¼" TEAC FD-55F DS/QUAD	$124.95
5¼" TEAC FD-55GFV DS/HD	$154.95
5¼" MITSUBISHI DS/HD	$119.95
3½" MITSUBISHI DS/DD	$129.95

AT & XT VERSIONS AVAILABLE OF THE 3.5" MITSUBISHI FDD

DISK DRIVE ACCESSORIES

TEAC SPECIFICATION MANUAL	$5.00
TEAC MAINTENANCE MANUAL	$25.00
½ HT MNTG HARDWARE FOR IBM	$2.95
MOUNTING RAILS FOR IBM AT	$4.95
"Y" POWER CABLE FOR 5¼" FDDs	$2.95
5¼" FDD POWER CONNECTORS	$1.19

SWITCH BOXES

ALL LINES SWITCHED, GOLD PLATED CONNECTORS, QUALITY SWITCHES

2 WAY $39.95

- CONNECTS 2 PRINTERS TO 1 COMPUTER OR VICE VERSA

AB-P *(CENTRONICS PARALLEL)*
AB-S *(RS232 SERIAL)*

3 WAY $99.95

- CONNECTS 3 PRINTERS TO 1 COMPUTER OR VICE VERSA

SWITCH-3P *(CENTRONICS PARALLEL)*
SWITCH-3S *(RS232 SERIAL)*

NASHUA DISKETTES

NASHUA DISKETTES WERE JUDGED TO HAVE THE HIGHEST POLISH AND RECORDED AMPLITUDE OF ANY DISKETTES TESTED (COMPARING FLOPPY DISKS, BYTE 9/84)

N-MD2D	DS/DD 5¼" SOFT	$9.90
N-MD2F	DS/QUAD 5¼" SOFT	$19.95
N-MD2H	DS/HD 5¼" FOR AT	$24.95
N-FD1	SS/DD 8" SOFT	$27.95
N-FD2D	DS/DD 8" SOFT	$34.95

BULK DISKETTE SALE

5¼" SOFT SECTOR, DS/DD W/TYVEC SLEEVES & HUB RINGS

49¢ea BULK QTY 50 — **39¢ea** BULK QTY 250

DISK DRIVE ENCLOSURES WITH POWER SUPPLIES

CAB-2SV5	DUAL SLIMLINE 5¼"	$49.95
CAB-1FH5	FULL HT 5¼"	$69.95
CAB-2SV8	DUAL SLIMLINE 8"	$209.95
CAB-2FH8	DUAL FULL HT 8"	$219.95

POWER STRIP $9.95

JDR PART #: POWER-STRIP

- 15 AMP CIRCUIT BREAKER
- 6 RECEPTACLES
- 6 FOOT POWER CORD
- PILOT SWITCH

WITH SURGE PROTECTION

JDR PART #: MT-660

$12.95

DISKETTE FILES

5¼" DISKFILE HOLDS 70 **$8.95**

3½" DISKFILE HOLDS 40 **$8.95**

BUILD STEVE CIARCIA'S INTELLIGENT EPROM PROGRAMMER

AS SEEN IN BYTE, OCT. 86

- STAND-ALONE OR RS-232 SERIAL OPERATION
- MENU SELECTABLE EPROM TYPES—NO CONFIGURATION JUMPERS
- PROGRAMS ALL 5V 27XXX EPROMS FROM 2716 TO 27512
- READ, COPY OR VERIFY EPROM
- UPLOAD/DOWNLOAD INTEL HEX FILES
- PROGRAMMER DRIVER USER MODIFIABLE

Kit includes PCB & all components except case & power supply

$199

CALL FOR VOLUME QUOTES

1200 BAUD MODEM WITH PC TALK III $69.95

TOTAL SYSTEM CONTROL FROM A SINGLE SLOT

SAVE THOSE VALUABLE SLOTS FOR SPECIALITY CARDS

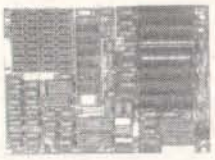
MCT-MGMIO $119.95

- HERCULES COMPATIBLE MONO-GRAPHICS, 720 x 384 PIXELS
- GAME PORT
- PARALLEL PORT & CLOCK/CALENDAR
- SERIAL PORT INCLUDED, OPTIONAL 2nd SERIAL AVAILABLE
- SUPPORTS BOTH DS/DD & DS/QD USING DOS 3.2 OR HIGHER

QUALITY IBM COMPATIBLE MOTHERBOARDS

TURBO 4.77 / 8 MHz $109.95

JDR PART #: MCT-TURBO



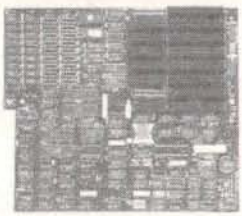
- 4.77 OR 8 MHz OPERATION WITH 8088-2 & OPTIONAL 8087-2 CO- PROCESSOR
- DYNAMICALLY ADJUSTS SPEED DURING DISKETTE OPERATION FOR MAXIMUM THROUGHPUT AND RELIABILITY
- CHOICE OF NORMAL / TURBO MODE OR SOFTWARE SELECT PROCESSOR SPEED

STANDARD MOTHERBOARD $97.95

JDR PART #: MCT-XTMB

80286 6 / 8 MHz $379.95

JDR PART #: MCT-ATMB



- 8 SLOT (2 EIGHT BIT, 6 SIXTEEN BIT) AT MOTHERBOARD
- HARDWARE SELECTION OF 6 OR 8 MHz
- 1 WAIT STATE
- RESET SWITCH, FRONT PANEL LED INDICATOR AND KEYLOCK SUPPORTED
- SOCKETS FOR 1 MB OF RAM AND 80287 ON BOARD
- ON BOARD BATTERY BACKED CLOCK OPERATES WITH PC-DOS OR MS-DOS

3½" FLOPPY DRIVE

JDR PART #s: FDD-3.5X (FOR XT)
FDD-3.5A (FOR AT)

- IBM COMPATIBLE
- 720K FORMAT, DOS 3.2 COMPATIBLE
- ALLOWS DATA INTERCHANGE WITH NEW IBM MACHINES
- MOUNTING HARDWARE FOR 5¼" SLOT
- AT AND XT VERSIONS AVAILABLE

$129.95

IBM COMPATIBLE FLOPPY DISK DRIVE

JDR PART #: FDD-360

GOOD QUALITY DRIVES BY MAJOR MANUFACTURERS SUCH AS QUME, TANDON & CDC

- 5¼" HALF HEIGHT
- DS/DD
- 360K STORAGE CAPACITY
- 48 TPI

$69.95

IBM XT STYLE COMPUTER CASE

AN ATTRACTIVE STEEL CASE WITH A HINGED LID. FITS THE POPULAR PC/XT COMPATIBLE MOTHERBOARDS

- SWITCH CUT-OUT ON SIDE FOR PC/XT STYLE POWER SUPPLY
- CUT-OUT FOR 8 EXPANSION SLOTS
- INCLUDES SPEAKER
- ALL HARDWARE INCLUDED

$34.95

XT STYLE SLIDE TYPE CASE $39.95
AT STYLE SLIDE TYPE CASE $89.95

BUILD YOUR OWN XT COMPATIBLE SYSTEM

MOTHERBOARD	$97.95
256K	$26.55
POWER SUPPLY	$59.95
XT STYLE CASE	$34.95
MCT KEYBOARD	$49.95
360K DRIVE	$69.95
DRIVE CONTROLLER	$29.95
MONITOR	$69.95
GRAPHICS CARD	$59.95
TOTAL	**$499.15**

IBM COMPATIBLE KEYBOARDS

MCT-5060 $59.95

- IBM AT STYLE LAYOUT
- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- EXTRA LARGE SHIFT & RETURN KEYS
- LED INDICATORS FOR SCROLL, CAPS & NUMBER LOCK
- AUTO REPEAT FEATURE

MCT-5339 $79.95

- IBM ENHANCED STYLE LAYOUT
- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- 12 FUNCTION KEYS
- EXTRA LARGE SHIFT & RETURN KEYS
- LED INDICATORS FOR SCROLL, CAPS & NUMBER LOCK
- AUTO REPEAT FEATURE
- SEPARATE CURSOR PAD

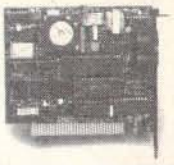
MCT-5150 $49.95
XT STYLE LAYOUT

MCT-5151 $69.95
KB5151™ EQIUVALENT

EASYDATA MODEMS

All models feature auto-dial/answer/redial on busy, Hayes compatible, power up self test, touchtone or pulse dialing, built-in speaker, PC Talk III Communications software, Bell Systems 103 & 212A full or half duplex and more.

INTERNAL



EASYDATA-12H $69.95
1200 BAUD HALF CARD

EASYDATA-12B $99.95
1200 BAUD 10" CARD

EASYDATA-24B $179.95
2400 BAUD FULL CARD

EXTERNAL

NO SOFTWARE INCLUDED

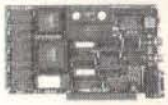
EASYDATA-12D $119.95
1200 BAUD

EASYDATA-24D $219.95
2400 BAUD

MCT DISPLAY CARDS

MCT-EGA $149.95

100% IBM COMPATIBLE, PASSES IBM EGA DIAGNOSTICS



- COMPATIBLE WITH IBM EGA, COLOR GRAPHICS AND MONOCHROME ADAPTORS
- TRIPLE SCANNING FREQUENCY FOR DISPLAY ON EGA, STANDARD RGB OR HIGH RES-OLUTION MONOCHROME MONITOR
- FULL 256K OF VIDEO RAM ALLOWS 640 x 350 PIXELS IN 16 OF 64 COLORS
- LIGHT PEN INTERFACE

MCT-CG $49.95

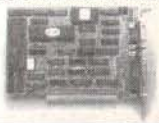
COMPATIBLE WITH IBM COLOR GRAPHICS STANDARD

- SHORT SLOT CARD USES VLSI CHIPS TO INSURE RELIABILITY
- SUPPORTS RGB, COMPOSITE MONOCHROME & COLOR AND AN RF MODULATOR OUTPUT
- 320 x 200 COLOR GRAPHICS MODE
- 640 x 200 MONOGRAPHICS MODE
- LIGHT PEN INTERFACE

SHORT SLOT

MCT-MGP $59.95

COMPATIBLE WITH IBM MONOCHROME AND HERCULES GRAPHICS STANDARDS



- SHORT SLOT CARD USES VLSI CHIPS TO INSURE RELIABILITY
- PARALLEL PRINTER PORT, CONFIGURABLE AS LPT1 OR LPT2
- 720 x 348 GRAPHICS MODE
- LOTUS COMPATIBLE
- CAN RUN WITH COLOR GRAPHICS CARD IN THE SAME SYSTEM

MCT DEVELOPMENT TOOLS

MCT-PAL PAL PROGRAMMER $269.95

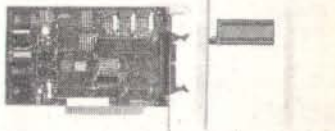
ONE ARRAY LOGIC CHIP CAN REPLACE 4-5 TTL ICs

- PROGRAMS 20 & 24 PIN PALS FROM TI, NSC & MMI
- EASY TO USE MENU-DRIVEN SOFTWARE ALLOWS PROGRAMMING, VERIFICATION READING, MAP BUILDING & BURNING THE SECURITY FUSE
- READ AND SAVE BURN PROFILES IN JEDEC FORMAT ON YOUR DISK

CUPL STARTER KIT $49.95

MCT-MP MICROPROCESSOR PROGRAMMER $199.95

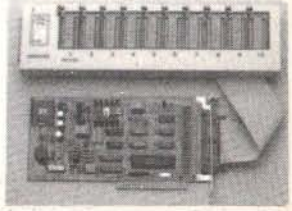
PROGRAMS 8741/2/8/9 PROCESSOR CHIPS



- EASY TO USE MENU-DRIVEN SOFTWARE SUPPORTS READ, WRITE, BLANK CHECK AND VERIFY OPERATIONS
- PORT ADDRESS SELECTION IS USER CONFIGURABLE
- SAVE AND RESTORE PROGRAM IMAGES ON DISK
- INCLUDES SOFTWARE FOR STANDARD HEX AND INTEL HEX FORMATS

MCT-EPROM EPROM PROGRAMMERS $129.95

PROGRAMS 27xx AND 27xxx SERIES EPROMS UP TO 27512



- SUPPORTS VARIOUS MANUFACTURERS FORMATS WITH 12.5, 21 AND 25 VOLT PROGRAMMIMG
- MENU-DRIVEN SOFTWARE ALLOWS EASY MANIPULATION OF DATA FILES
- SPLIT OR COMBINE THE CONTENTS OF SEVERAL EPROMS OF DIFFERENT SIZES
- READ, WRITE, COPY, ERASE CHECK AND VERIFY WITH EASY ONE KEY SELECTION
- INCLUDES SOFTWARE FOR STANDARD HEX AND INTEL HEX FORMATS

4 GANG PROGRAMMER $189.95
10 GANG PROGRAMMER $299.95

MCT PRODUCTS CARRY A ONE YEAR WARRANTY

BUILD AN AT COMPATIBLE FOR UNDER $1050

MULTIFUNCTION CARDS

FROM MODULAR CIRCUIT TECHNOLOGY

MCT-MF $79.95

ALL THE FEATURES OF AST'S SIX PACK PLUS AT HALF THE PRICE!

- 0-348K DYNAMIC RAM USING 4164s
- INCLUDES SERIAL PORT, PARALLEL PRINTER PORT, GAME CONTROLLER PORT AND CLOCK/CALENDAR
- SOFTWARE FOR A RAMDISK, PRINT SPOOLER AND CLOCK/CALENDAR

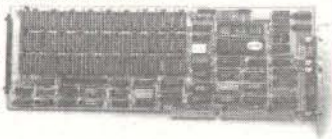
MCT-ATMF $139.95

ADDS UP TO 3 MB OF 1 BIT RAM TO THE AT

- USER EXPANDABLE TO 1.5 MB OF ON-BOARD MEMORY (NO MEMORY INSTALLED)
- FLEXIBLE ADDRESS CONFIGURATION
- INCLUDES SERIAL PORT AND PARALLEL PORT
- OPTIONAL PIGGYBACK BOARD PERMITS EXPANSION TO 3 MB

ATMF-SERIAL 2nd SERIAL PORT $24.95

MCT-ATMF-MC $29.95
PIGGYBACK BOARD (ZERO K INSTALLED)

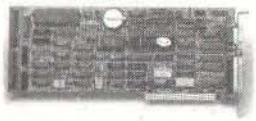


MCT-MIO $79.95

A PERFECT COMPANION FOR OUR MOTHERBOARD

- 2 DRIVE FLOPPY DISK CONTROLLER
- INCLUDES SERIAL PORT, PARALLEL PORT, GAME PORT AND CLOCK/CALENDAR WITH BATTERY BACK-UP
- SOFTWARE FOR A RAMDISK, PRINT SPOOLER AND CLOCK/CALENDAR

MIO-SERIAL 2nd SERIAL PORT $15.95



MCT-IO $59.95

USE WITH MCT-FH FOR A MINIMUM OF SLOTS USED

- SERIAL PORT ADDRESSABLE AS COM1, COM2, COM3 OR COM4
- PARALLEL PRINTER PORT ADDRESSABLE AS LPT1 OT LPT2 (x378 OR x278)
- CLOCK/CALENDAR WITH A BATTERY BACK-UP

IO-SERIAL 2nd SERIAL PORT $15.95

SHORT SLOT

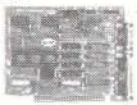
MCT-ATIO $59.95

USE WITH MCT-ATFH FOR A MINIMUM OF SLOTS USED

- SERIAL PORT ADDRESSABLE AS COM1, COM2, COM3 OR COM4
- PARALLEL PRINTER PORT ADDRESSABLE AS LPTA OR LPTB (x378 OR x278)
- GAME PORT
- USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPERATION IN AN AT

ATIO-SERIAL 2nd SERIAL PORT $24.95

SHORT SLOT



RAM CARDS

FROM MODULAR CIRCUIT TECHNOLOGY

MCT-RAM $59.95

A CONTIGUOUS MEMORY SOLUTION FOR YOUR SHORT OR REGULAR SLOT

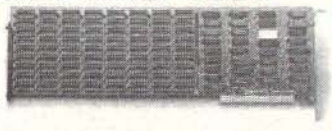
- SHORT SLOT, LOW POWER PC COMPATIBLE DESIGN
- CAN OFFER UP TO 576K OF ADDITIONAL MEMORY
- USER SELECTABLE CONFIGURATION AMOUNTS OF 192, 384, 512, 256 & 576K, USING COMBINATIONS OF 64 & 256K RAM

SHORT SLOT

MCT-EMS $129.95

2MB OF LOTUS/INTEL/MICROSOFT COMPATIBLE MEMORY FOR THE XT

- CONFORMS TO LOTUS/INTEL EMS
- USER EXPANDABLE TO 2 MB
- USES 64K OR 256K DYNAMIC RAM (NO MEMORY INSTALLED)
- USE AS EXPANDED OR CONVENTIONAL MEMORY, RAMDISK OR SPOOLER
- SOFTWARE INCLUDES EMS DEVICE DRIVERS, PRINT SPOOLER AND RAMDISK

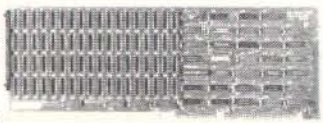


MCT-ATEMS $139.95

CAN BE USED FOR CONVENTIONAL, EXPANDED OR EXTENDED MEMORY

- A FINE EXAMPLE OF FLEXIBILITY: OFFERS EXTENDED (AT MEMORY) OR EXPANDED (LIM/EMS) MEMORY AS WELL AS THE ABILITY TO FILL OUT CONVENTIONAL (640K) MEMORY
- 2 MEGABYTE CAPACITY IN A SINGLE SLOT
- RAMDISK, PRINT SPOOLER AND LIM/EMS SOFTWARE INCLUDED
- SPECIAL MEMORY MAP ANALYSIS INCLUDED

MCT-ATEMS-MC $34.95
PIGGYBACK BOARD (ZERO K INSTALLED)



Seagate

HALF HEIGHT HARD DISK DRIVES

40 MB — *Model ST-251 5¼" half height FAST 40ms access time* — **$469**

60 MB — *Model ST-277 5¼" half height FAST 40ms access time (RLL)* — **$649**

HALF HEIGHT HARD DISK SYSTEMS

20 MB $289

30 MB $329

Systems include half height hard disk drive, hard disk drive controller, cables and instructions. All drives are pre-tested and warranted for one year.

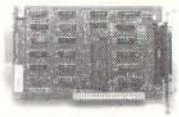
DISK CONTROLLER CARDS

FROM MODULAR CIRCUIT TECHNOLOGY

MCT-FDC $29.95

QUALITY DESIGN OFFERS 4 FLOPPY CONTROL IN A SINGLE SLOT

- INTERFACES UP TO 4 FDDs TO AN IBM PC OR COMPATIBLE
- INCLUDES CABLING FOR 2 INTERNAL DRIVES
- USES STANDARD DB37 CONNECTOR FOR EXTERNAL DRIVES
- SUPPORTS BOTH DS/DD AND DS/QD WHEN USED W/ DOS 3.2 OR JFORMAT



MCT-HDC $79.95

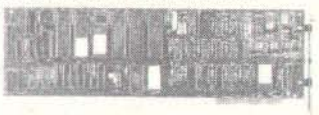
HARD DISK CONTROL FOR WHAT OTHERS CHARGE FOR FLOPPY CONTROL

- IBM XT COMPATIBLE CONTROLLER SUPPORTS 16 DRIVE SIZES INCLUDING 5, 10, 20, 30 & 40MB
- OPTIONS INCLUDE THE ABILITY TO DIVIDE 1 LARGE DRIVE INTO 2 SMALLER, LOGICAL DRIVES
- INCLUDES CABLING FOR 1 INTERNAL DRIVE

MCT-RLL $119.95

GET UP TO 50% MORE STORAGE SPACE ON YOUR HARD DISK

- INCREASES THE CAPACITY OF PLATED MEDIA DRIVES BY 50%
- RLL 2,7 ENCODING FOR MORE RELIABLE STORAGE
- TRANSFER RATE IS ALSO 50% FASTER; 750K/sec vs 500K/sec
- USE WITH ST-238 DRIVE TO ACHIEVE 30+ MB IN A HALF HEIGHT SLOT



MCT-FH $139.95

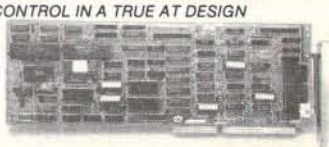
STARVED FOR SLOTS? SATISFY IT WITH THIS TIMELY DESIGN

- INTERFACES UP TO 2 FDDs & 2 HDDs
- CABLING FOR 2 FDDs & 1 HDD
- FLOPPY INTERFACE SUPPORTS BOTH DS/DD & DS/QD WHEN USED WITH DOS 3.2 OR JFORMAT
- ALL POPULAR HDD SIZES ARE SUPPORTED, INCLUDING 5, 10, 20, 30 & 40MB
- CAN DIVIDE 1 LARGE DRIVE INTO 2 SMALLER, LOGICAL DRIVES

MCT-ATFH $149.95

FLOPPY AND HARD DISK CONTROL IN A TRUE AT DESIGN

- AT COMPATIBLE, CONTROL UP TO 2 360K/720K OR 1.2MB FDDs AS WELL AS 2 HDDs USING THE AT STANDARD CONTROL TABLES
- SUPPORTS AT STYLE FRONT PANEL LED TO INDICATE HD ACTIVITY
- 16 BIT BUSS PROVIDES RAPID DATA TRANSFERS
- FULLY SUPPORTED BY AT BIOS



JDR Microdevices 110 Knowles Drive, Los Gatos, CA 95030
Toll Free 800-538-5000 • (408) 866-6200 • FAX (408) 378-8927 • Telex 171-110

BOMB

YOU CHOOSE THE BEST ARTICLE EACH MONTH

BYTE's ongoing monitor box (BOMB) lets you rate each article you've read in BYTE as excellent, good, fair, or poor. Each month, you can mail in the BOMB card found in the back of the issue. We tally your votes, total the points, tell you who won, and award the two top-rated nonstaff authors $100 and $50, respectively. An additional $50 award for quality goes to the nonstaff author with the best average score (total points divided by the number of voters). If you prefer, you can use BIX as your method of voting. We welcome your participation.

ARTICLE#	PAGE	ARTICLE	AUTHOR(S)
1	37	**Microbytes**	staff
2	45	**What's New**	staff
3	68	**Ask BYTE/Circuit Cellar Feedback**	Ciarcia
4	81	**Book Reviews**	Olson, Kirkpatrick, Kirwan
5	100	**The Tandy Anniversary Product Explosion**	Malloy, Vose, Stewart
6	109	**The OS/2 Applications Family**	Duncan
7	121	**Product Preview: A Spiritual Heir to the Macintosh**	Shapiro
8	125	**Product Preview: The Archimedes A310**	Pountain
9	135	**Ciarcia's Circuit Cellar: Build the Circuit Cellar AT Computer, Part 2: Schematic**	Ciarcia
10	149	**Zero-Knowledge Proofs**	Wayner
11	155	**Back-Propagation**	Jones, Hoskins
12	165	**Optimizing Compilers**	Roberts
13	173	**A Search Strategy for Commonsense Logic Programming**	Haley
14	177	**Mathematical Reasoning**	Sterling
15	183	**Neural-Network Heuristics**	Josin
16	197	**The Macintosh II**	Webster
17	202	**The GRiDLite Laptop**	Unger
18	203	**The Wang LapTop**	Lane
19	209	**The Definicon DSI-780**	Thomas
20	214	**Laser Printer Times Four**	Rash
21	223	**Three C Language Screen-Utility Packages for PCs**	Robie
22	229	**Advantage C++ and Guidelines C++**	Mallett
23	237	**Equation Solvers**	Stewart
24	242	**Personal Consultant Plus**	Tello
25	244	**Guide**	Hershey
26	251	**Computing at Chaos Manor: New Life for Lucy**	Pournelle
27	269	**Applications Only: Into the 4th Dimension, Part 1**	Shapiro
28	275	**Best of BIX**	BIXen

BOMB RESULTS

The results for July find What's New from the BYTE staff walking off with top honors. Richard Grehan takes second for his review, "The IBM PS/2 Model 50." Microbytes, also from the BYTE staff, shows in third. The fourth-place finisher is Curtis Franklin Jr. for his review, "The IBM PS/2 Model 30." In fifth place, and this month's winner of $100, is Dick Lefkon for "A LAN Primer." Steve Ciarcia's "Using the ImageWise Video Digitizer, Part 1: Image Processing" is sixth. "A Taxing Day" gains seventh place for Jerry Pournelle. "High-Tech Horsepower," another BYTE staff effort, lands in eighth place. David Gedeon wins $50 for a Programming Insight, "Complex Math in Pascal." The $50 award for quality goes to Mr. Lefkon.

We also have the results for our *Applications Software Today* special issue. In first place, and the winner of $100, is Phillip Robinson for his review, "Word Processors." The second-place finisher, and winner of $50, is Bill Gates for "Beyond Macro Processing." Mr. Robinson also wins the $50 award for quality. Congratulations to all.

COMING UP IN BYTE

Products In Perspective:
BYTE will have a new look beginning in November, and the Products in Perspective section is an example. One new type of article, called First Impressions, will provide the very latest information about new products while retaining the depth of coverage traditional to BYTE.

Reviews:
There's a new perspective in the review section, too. We'll lead off with a group review—80286 accelerator boards, in November—and follow it with a BIX-generated discussion on the product category in question.

System reviews include the IBM PS/2 Model 80 and two other 80386-based machines. Peripherals include upgrades for the Mac SE and pocket modems. Languages include a group review of FORTRANs and MetaWare C/386. Applications include Finite Element Analysis and Wordcruncher.

In Depth:
This new name for the Theme section gives a clearer indication of its role—to focus on a particular segment of microcomputing and discuss it in depth. Workstations are covered in November, and we'll have a roundup article, a windowing system comparison, Apple Unix on the Macintosh, standards, and graphics engines.

Features:
Steve Ciarcia begins a two-part article on building an integrated circuit tester. Other features are an algorithm for XMODEM CRCs and Dick Pountain's article on algorithms for a freehand paint program.

EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue.
Each reference is to the first page of the article or section in which the company name appears.

BYTE ADVERTISING SALES STAFF:

Dennis J. Riley, Advertising Sales Manager, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281

NEW ENGLAND
ME, NH, VT, MA, RI,
ONTARIO, CANADA & EASTERN CANADA
Paul McPherson Jr. **(617) 262-1160**
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Leah G. Rabinowitz **(212) 512-2096**
McGraw-Hill Publications
1221 Avenue of the Americas—
39th Floor
New York, NY 10020

Dick McGurk **(203) 968-7111**
McGraw-Hill Publications
Building A—3rd Floor
777 Long Ridge Road
Stamford, CT 06902

EAST
PA, KY, OH, NJ (SOUTH),
MD, VA, W.VA, DE, D.C.
Daniel Ferro **(215) 496-3833**
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102

NORTHEAST MAIL ORDER AND RETAIL ACCOUNTS
Bill Watson **(603) 924-7255**
One Phoenix Mill Lane
Peterborough, NH 03458

SOUTHEAST
NC, SC, GA, FL, AL, TN
Carolyn F. Lovett **(404) 252-0626**
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 420
Atlanta, GA 30319

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI,
NB, IN, MI, MS
Bob Denmead **(312) 751-3740**
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611

SOUTHWEST, ROCKY MOUNTAIN
CO, WY, OK, TX, AR, LA
(214) 644-1111
McGraw-Hill Publications
8111 LBJ Freeway—Suite 1350
Dallas, TX 75251

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS
Jack Anderson **(714) 557-6292**
McGraw-Hill Publications
3001 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626

Tom Harvey **(213) 480-5243**
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA,
NV (except LAS VEGAS), UT,
W. CANADA
Mike Kisseberth **(415) 362-4600**
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111

Bill McAfee **(415) 349-4100**
McGraw-Hill Publications
951 Mariner's Island Blvd.—3rd Floor
San Mateo, CA 94404

The Buyer's Mart (1x2)
Mark Stone **(603) 924-3754**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE BITS (2x3)
Dan Harper **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck Mailings National
Ed Ware **(603) 924-6166**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

A/E/C Computing Deck
Mary Ann Goulding **(603) 924-9281**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

International Advertising Sales Staff:

Mr. Hans Csokor
Publimedia
Reisnerstrasse 61
A-1037 Vienna, Austria
222 75 76 84

Mrs. Gurit Gepner
McGraw-Hill Publishing Co.
PO Box 2156
Bat Yam, 59121 Israel
3 866 561 321 39

Mr. Fritz Krusebecker
McGraw-Hill Publishing Co.
Liebigstrasse 19
D-6000 Frankfurt/Main 1
West Germany
69 72 01 81

Mrs. Maria Sarmiento
Pedro Teixeira 8, Off. 320
Iberia Mart 1
Madrid 4, Spain
1 45 52 891

Mr. Gert Moberg
Andrew Karnig & Associates
Finnbodavagen
S-131 31 Nacka, Sweden
8-44 0005

Mr. Alain Faure
McGraw-Hill Publishing Co.
128 Faubourg Saint Honore
75008 Paris
France
(1) 42-89-03-81

Mr. Arthur Scheffer
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 3RA
England 01 493 1451

Manuela Capuano
McGraw-Hill Publishing Co.
Via Flavio Baracchini 1
20123 Milan, Italy
02 86 90 617

Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 734-9790
Telex: RS35539 SEAVEX

Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 5-260149
Telex: 60904 SEVEX HX

Hiro Morita
McGraw-Hill Publishing Co.
Overseas Corp
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
3 581 9811

Mr. Ernest McCrary
Empresa Internacional de
Comunicacoes Ltda.
Rua da Consolacao, 222
Conjunto 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company

Alphabetical Index to Advertisers

Continued

READER SERVICE

* Correspond directly with company

Inquiry No.		Page No.
INTERNATIONAL SECTION		
No domestic inquiries please.		
500	A.L. DOWNLOADING	64A-21
501	ALADDIN KNOWLEDGE SYS.	64A-12
502	APPLIED LOGIC SYSTEMS	64A-14
503	ASHFORD INT'L.	64A-1
*	BYTE BITS	64A-18
*	BYTE MARKETING	64A-15
505	COMLEX	64A-21
506	COMLINE ENGINEERING	64A-21
507	COMPUADD	64A-2
531	CONNEXIONS	64A-23
508	CUT PRICE SOFTWARE	64A-18
509	C.A.S. COMPUTER POINT	64A-23
510	DDF PERTEC	64A-23
511	DIAMOND POINT SOFTWARE	64A-23
512	DIAMOND SOFTWARE	64A-21
*	ELECTRONICS	64A-24
*	ELECTRONICS	CARD
514	EURO-LINK, INC.	64A-23
515	FACIT AB	64A-5
516	FORMAT PC	64A-21
517	GAMMA PRODUCTIONS	64A-4
518	GREY MATTER	64A-19
519	HI-SPEC SYSTEMS LTD.	64A-21
520	MAGNETIC MEDIA MARKET	64A-21
521	MAYFAIR MICROS	64A-17
522	MICROGOLD	64A-23
523	MICROPROCESSOR ENGIN.	64A-21
524	MITSUBISHI CHEMICAL	64A-8
525	MPD ASSOC.	64A-23
526	MUENCHENER MESSE	64A-13
527	NOKIA INFO. SYS.	64A-7
528	PECAN S/W	64A-23
529	QA TRAINING	64A-11
532	TECHTRADE	64A-10
533	TRIANGLE DIGITAL SERV.	64A-23
534	TRUST INTERNATIONAL	64A-22
535	TYEPRO LTD.	64A-21

REGIONAL SECTION

Inquiry No.		Page No.
Greater NYC/Tri-State Area		**192 NY 1-8**
401	ASTRO SYSTEMS	NY-5
*	COMPUTERS FOR THE BLIND	NY-2
402	COTTAGE COMPUTERS	NY-2
403	ELCO	NY-7
404	LIVING SOFTWARE	NY-6
405	MAGITRONIC TECH. INC.	NY-1
*	MCGRAW-HILL BOOKS	NY-4
*	PC LINK	NY-3
407	SSE PRODUCTS	NY-6
408	WHITEWATER GROUP	NY-8
LA/San Diego Southern California		**192 SCA 1-8**
*	APPLE COMP. EMPLOYMENT	SCA-2
411	EL TORO	SCA-4
412	INCOMM DATA SYSTEMS INC.	SCA-3
413	LLOYD I/O, INC.	SCA-4
*	MCGRAW-HILL BOOKS	SCA-6
*	MICROMINT	SCA-7
414	QUALITY MICRO	SCA-5
415	RIX SOFTWORKS INC.	SCA-1
416	RIX SOFTWORKS INC.	SCA-1
417	UNITED COMP. RES.	SCA-8
Pacific Northwest		**192 PNW 1-8**
*	APPLE COMP. EMPLOYMENT	PNW-8
*	COMP. FOR THE BLIND	PNW-4
419	DIAMOND SOFTWARE	PNW-7
*	EXPOCONSUL INT'L, INC.	PNW-3
420	ITRON	PNW-2
421	MERCURY COMP. CORP.	PNW-5
422	NETWORK ASSOCIATES	PNW-6
423	PRINTER WORKS, THE	PNW-1
424	TATUNG SCI. & TECH.	PNW-4
Midwest		**192 MW 1-8**
427	CSI/COMPONENT SYS. INC.	MW-4
*	COMP.FOR THE BLIND	MW-8
*	EXEC-PC INC.	MW-5
429	ITRON	MW-3
430	KGB ENTERPRISES	MW-8
431	TECHNOLOGY MARKETING	MW-2
432	TOTAL SOLNS. CONSULTANTS	MW-1
*	ULTRA COMP	MW-6,7
434	WHOLESALE COMP. ELECT	MW-2
435	Y.E.S. MULTINATIONAL	MW-4
Northeast		**192 NE 1-8**
*	COMPUTER MUSEUM	NE-8
*	COMP. FOR THE BLIND	NE-2
439	HORIZON SALES	NE-2
440	ITRON	NE-5
*	MCGRAW-HILL BOOKS	NE-7
*	MICROMINT	NE-4
441	RIX SOFTWORKS INC.	NE-1
442	RIX SOFTWORKS INC.	NE-1
*	ROBERT TINNEY GRAPHICS	NE-6
443	THE COMP. WAREHOUSE	NE-3
Southeast		**192 SE 1-8**
447	BULLDOG COMP. PRODS.	SE-4,5
448	COMPUTER PRODS. CORP.	SE-1
449	KNAPCO	SE-7
*	MCGRAW-HILL BOOKS	SE-8
*	MICROMINT	SE-6
*	ROBERT TINNEY GRAPHICS	SE-2
451	SUNNYVALE MEMORIES	SE-3
Mid-Atlantic		**192 M/AT 1-8**
454	COTTAGE COMPUTER	M/AT-4
455	ITRON	M/AT-5
456	KEN GORDON PRODNS	M/AT-4
*	MCGRAW-HILL BOOKS	M/AT-6
*	MICROMINT	M/AT-7
*	ROBERT TINNEY GRAPHICS	M/AT-8
457	TOTAL SOLNS. CONSULTANTS	M/AT-1
458	WESTERN SYSTEMS	M/AT 2,3

TIPS SUBSCRIBERS ONLY!*

Use BYTE's Telephone Inquiry Processing System

Using TIPS can bring product information as much as 10 days earlier.

SEND FOR YOUR SUBSCRIBER I.D. CARD

1) If you are a new subscriber or have lost your I.D. card, circle #1 on the Reader Service Card; **attach mailer label**. We will immediately send your personal TIPS subscriber card.

GET PREPARED

2) Write your Subscriber Number, as printed on your Subscriber I.D. Card, in boxes in Step 5 below. (Do not add 0's to fill in blank boxes)

3) Write numbers for information desired in boxes in Step 7b below. (Do not add 0's to fill in blank boxes.)

CALL TIPS

4) Now, on a Touch-Tone telephone dial: **(413) 442-2668** and wait for voice commands.

ENTER YOUR SUBSCRIBER AND ISSUE NUMBERS

5) When TIPS says: "Enter Subscriber Number"
(Enter by pushing the numbers and symbols [# or * enclosed in the boxes] on telephone pad ignoring blank boxes)
Enter ☐☐☐☐☐☐☐☐☐#[#]

6) When TIPS says "Enter magazine code & issue code"
Enter [1][#][1][0][7][#][#]

ENTER YOUR INQUIRIES

7a) When TIPS says "Enter (next) Inquiry Number"
Enter one inquiry selection from below (ignore blank boxes)

b) Repeat 7a as needed (maximum 17 inquiry numbers)

1.	☐☐☐#[#]	6.	☐☐☐#[#]	10.	☐☐☐#[#]	14.	☐☐☐#[#]		
2.	☐☐☐#[#]	7.	☐☐☐#[#]	11.	☐☐☐#[#]	15.	☐☐☐#[#]		
3.	☐☐☐#[#]	8.	☐☐☐#[#]	12.	☐☐☐#[#]	16.	☐☐☐#[#]		
4.	☐☐☐#[#]	9.	☐☐☐#[#]	13.	☐☐☐#[#]	17.	☐☐☐#[#]		
5.	☐☐☐#[#]								

END SESSION

8) End session by entering [*][*][9][1][#][#]

9) Hang up after hearing final message
If you are a subscriber and need assistance, call (603) 924-9281.

Available 24 Hours, 7 Days a Week

If you are not a subscriber fill out the subscription card found in this issue or, call BYTE Circulation 800-423-8912.

***Domestic and Canadian Subscribers Only!**

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company

Index to Advertisers by Product Category

Continued

READER SERVICE

* Correspond directly with company

THREE NEW WAYS TO SHOW YOUR DISDAIN FOR MEDIOCRITY.

In a world where a startling number of products are made to standards that are somewhat less than exacting, NEC presents a trio of products that elevate those standards significantly.

It's the APC IV PowerMate™ family of personal business computers: PowerMate 1, PowerMate 2 and the multi-user BusinessMate.™ They're part of a new line of AT-class PCs that give you the kind of power and speed you need to take your productivity—and your creativity—to the limit. And with the latest addition to the family—our brand new PowerMate 386—you can stretch that limit even further.

So even though life may indeed be a series of compromises, we don't think you should have to settle for one in the office. Not when you can get the name of your nearest NECIS reseller just by calling 1-800-343-4419 (in MA 617-264-8635). In Canada call 1-800-387-4313. Or write to NEC Information Systems, Department 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

Take it to the limit.

NEC

NEC Information Systems, Inc.

C&C Computers and Communications

Circle 192 on Reader Service Card

Tandy Computers: Because there is no better value.™

The New Tandy® 1000 TX

The most affordable 80286-powered PC compatible made in America.

Our new 1000 TX features an 8 MHz 80286 microprocessor, for far greater processing power than ordinary PCs. This brings true 16-bit technology, previously found only in "AT®" class machines to an affordable PC.

The Tandy 1000 TX is outfitted with a new high-capacity 720K 3½" disk drive, and there's room to add a second internal 3½" or 5¼" disk drive.

The 1000 TX includes features you'd expect to pay extra for, like monochrome and color graphics adapters, a printer adapter, joystick adapter and an RS-232C serial port. We also include MS-DOS® 3.2 and GW-BASIC—even our new integrated software program: Personal DeskMate™ 2.

The Tandy 1000 TX comes with 640K RAM and five card slots for expansion. Add more memory, an internal modem, a hard disk card—or an adapter card for connecting the 1000 TX to your workgroup environment.

Come into your local Radio Shack and see the new Tandy 1000 TX today—only $1199. (25-1600)

Radio Shack®

The Technology Store™

A DIVISION OF TANDY CORPORATION

Price applies at Radio Shack Computer Centers and participating stores and dealers. Monitor sold separately. Personal DeskMate 2 requires an 80-column monitor. AT/Reg. TM IBM. MS-DOS/Reg. TM Microsoft Corp.

Circle 232 on Reader Service Card